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CORRECTIVE MEASURES STUDY REPORT SOLID WASTE MANAGEMENT UNIT 6 (SWMU 6) ZONE G CNC CHARLESTON SC

8/15/2006

CH2M HILL

CORRECTIVE MEASURES STUDY REPORT

SWMU 6, Zone G

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

CH2M-Jones

August 2006

Contract N62467-99-C-0960

Rev 1 Changes

THE ATTACHED PAGES SHOULD BE INSERTED AS REPLACEMENTS IN THE *CORRECTIVE MEASURES STUDY REPORT, SWMU 6, ZONE G, REVISION 0* SUBMITTAL:

- ✓ REVISED COVER AND SPINE
- ✓ REVISED INSIDE COVER
- ✓ REVISION 1 CERTIFICATION PAGE
- ✓ REVISED TABLE OF CONTENTS PGS III-V
- ✓ REVISED SECTION 1.4, PG 1-10
- REVISED SECTION 3.0
- ✓ NEW APPENDIX C: CH2M-JONES' RESPONSES TO SCDHEC COMMENTS ON THE CORRECTIVE MEASURES STUDY REPORT, SWMU 6, ZONE G, REVISION 0 (JUNE 2004)

8-18-06 / ✓ = inserted & affected pages removed

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CH2MHILL

August 15, 2006

Mr. David Scaturo
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: Corrective Measures Study (CMS) Report (Revision 1) – SWMU 6, Zone G

Dear Mr. Scaturo:

Enclosed please find two copies of the CMS Report (Revision 1) for SWMU 6 in Zone G of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

Please contact me at 352/335-5877, ext. 52280, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Dann Spariosu/USEPA, w/att
Dudley Patrick/Navy, w/att
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October 14, 2003

Mr. David Scaturo
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: CMS Report (Revision 0) – SWMU 6, Zone G

Dear Mr. Scaturo:

Enclosed please find two copies of the CMS Report (Revision 0) for SWMU 6 in Zone G of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

Please contact me at 352/335-5877, ext. 2280, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

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CORRECTIVE MEASURES STUDY REPORT

SWMU 6, Zone G

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

PREPARED BY
CH2M-Jones

August 2006

Revision 1
Contract N62467-99-C-0960
258814.PM.13

Certification Page for Corrective Measures Study Report (Revision 1) — SWMU 6, Zone G

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that the qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

South Carolina

P.E. No. 21428

Dean Williamson, P.E.

8/16/2006

Date

Certification Page for Corrective Measures Study Report (Revision 0) — SWMU 6, Zone G

I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428

Dean Williamson

Dean Williamson, P.E.

10/4/2005

Date

Contents

Contents, Continued

Contents, Continued

Acronyms and Abbreviations

AOC	area of concern
BCT	BRAC Cleanup Team
BEQ	benzo(a)pyrene equivalent
BHC	benzene hexachloride
BRAC	Base Realignment and Closure Act
CA	corrective action
CFR	Code of Federal Regulations
CMS	corrective measures study
CNC	Charleston Naval Complex
COC	chemical of concern
COPC	chemical of potential concern
CPW	Charleston Public Works
DAF	dilution attenuation factor
DDD	dichlorodiphenyldi-chloroethane
DDE	dichlorodiphenyldichloro-ethene
DDT	dichlorodiphenyltrichloro-ethane
DET	Environmental Detachment Charleston
EBASCO	Electric Bond and Security Company
EEG	Environmental Enterprise Group
EnSafe	EnSafe, Inc.
EPA	U.S. Environmental Protection Agency
ft bls	feet below land surface
HI	hazard index
ILCR	Incremental Lifetime Cancer Risk
IM	interim measure
IMCR	Interim Measure Completion Report

Acronyms and Abbreviations, Continued

LUC	land use control
LUCMP	land use control management plan
µg/L	microgram per liter
mg/L	milligram per liter
mg/kg	milligram per kilogram
MCL	maximum contaminant level
MCS	media cleanup standard
msl	mean sea level
NAVBASE	Naval Base
NFA	no further action
NTU	nephelometric turbidity unit
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RGO	remedial goal option
SCDHEC	South Carolina Department of Health and Environmental Control
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
VOC	volatile organic compound
UST	underground storage tank
UCL_{95}	95% Upper Confidence Limit
yd^3	cubic yard

Section 1.0

1.0 Introduction

In 1993, Naval Base (NAVBASE) Charleston was added to the list of bases scheduled for closure as part of the Defense Base Realignment and Closure Act (BRAC), which regulates closure and transition of property to the community. The Charleston Naval Complex (CNC) was formed as a result of the dis-establishment of the Charleston Naval Shipyard and NAVBASE on April 1, 1996.

Corrective Action (CA) activities are being conducted under the Resource Conservation and Recovery Act (RCRA), with the South Carolina Department of Health and Environmental Control (SCDHEC) as the lead agency for CA activities at the CNC. All RCRA CA activities are performed in accordance with the Final Permit (Permit No. SC0 170 022 560). In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation and remediation services at the CNC.

The Zone G RCRA Facility Investigation (RFI) was conducted in 1996 and 1997 to investigate the nature and extent of environmental contamination at the former Public Works Storage Yard (Old Corral), known as Solid Waste Management Unit (SWMU) 6, and to recommend whether additional site activities such as corrective actions would be required to eliminate or minimize unacceptable risks to human health or the environment. Results of the RFI were presented in the *Zone G RCRA Facility Investigation Report, Revision 0* (EnSafe Inc. [EnSafe], 1998).

RCRA CA Interim Measures (IMs) were performed at SWMU 6 by the Environmental Enterprise Group (EEG) (also known as the DET) in 1998, including the removal of contaminated soil. CH2M-Jones prepared IM work plans and implemented an additional IM for soil sampling and excavation in 2002. These IMs are summarized in Section 1.4.

An RFI Report Addendum, IM Completion Report (IMCR), and Corrective Measures Study (CMS) Work Plan were subsequently prepared for SWMU 6 by CH2M-Jones (CH2M-Jones, 2002a). A CMS was recommended to address shallow groundwater at SWMU 6. The CMS Work Plan (Section 9.0 of the RFI Report Addendum) presented the remedial action objectives (RAOs) and media cleanup standards (MCSs) proposed for SWMU 6.

Aroclor 1254 in surface soil was retained as a chemical of concern (COC) for the unrestricted land use scenario on the basis of a single soil sampling result collected during the installation of monitoring well G006GW005. Soil samples around this well do not show

Aroclor 1254 to be present above the residential risk-based concentration (RBC) of 0.32 milligrams per liter (mg/L). The 95% Upper Confidence Limit (UCL_{95}) estimate for the exposure point concentration for Aroclor 1254 was below the residential RBC; however, the BRAC Cleanup Team (BCT) agreed to retain Aroclor 1254 as a surface soil COC and perform additional soil sampling to confirm the absence of Aroclor 1254 as part of the CMS phase. If additional soil samples confirm its absence, it may be eliminated as a COC.

In addition, several groundwater COCs were identified on the basis of sampling conducted in 2002. Dichlorodiphenyldichloro-ethene (DDE) and dichlorodiphenyltrichloro-ethane (DDT), antimony, and nickel were retained as shallow groundwater COCs. A CMS was recommended to address these COCs in groundwater.

This CMS report has been prepared by CH2M-Jones to complete the next stage of the CA process for SWMU 6.

1.1 Corrective Measures Study Report Purpose and Scope

This CMS report evaluates corrective measure alternatives for contaminated groundwater at SWMU 6 in Zone G. Figure 1-1 illustrates the location of SWMU 6 within Zone G. Figure 1-2 is an aerial photograph showing the layout of SWMU 6.

This CMS report consists of: 1) the identification of a set of corrective measure alternatives that are considered to be technically appropriate for addressing pesticides and metals in groundwater; 2) an evaluation of the alternatives using standard criteria from U.S. Environmental Protection Agency (EPA) RCRA guidance; and 3) the selection of a recommended (preferred) corrective measure alternative for the site.

1.2 Background Information

This section of the CMS report presents background information on the facility, site history, and a summary of the nature and extent of the COCs at the site. This information is essential to the understanding of the RGOs, MCSs, and ultimately the evaluation of corrective measure alternatives for SWMU 6 in Zone G of the CNC. Additional information on the site and hydrogeology in the Zone G area of the CNC is provided in the *Zone G RFI Report, Revision 0* (EnSafe, 1998).

1.2.1 Facility Description

SWMU 6, the Public Works Storage Yard (Old Corral); SWMU 7, the polychlorinated biphenyl (PCB) Transformer Storage Yard; and Area of Concern (AOC) 635, the Paint and

Oil Storehouse, are located in Zone G (see Figure 1-1). SWMU 7 and AOC 635 are located within SWMU 6. These sites are located within the triangle formed by Kilo Street, Pierside Street, and Hobson Avenue. The locations of these SWMUs and AOC are shown on Figure 1-2. Each site is described in the following paragraphs.

SWMU 6 - Public Works Storage Yard

SWMU 6 is an open, unpaved fenced area where containerized hazardous wastes from vehicle maintenance, building maintenance, and pest control operations were stored prior to shipment. The RCRA Facility Assessment (RFA) (EBASCO, August 1987) identified cleaning solvents, waste oils, and paint wastes as potential contaminants at SWMU 6. Evidence of spills were not identified in the RFA, but a soil sampling effort in 1987 indicated soils were contaminated with metals.

SWMU 7 - PCB Transformer Storage Yard

SWMU 7 included Building 3902, the concrete slab outside the building, and the surrounding area. SWMU 7 was used to store transformers and other electrical equipment between 1970 and 1976. Visual evidence of past oil spills was reported in the RFA (EBASCO, 1987). Groundwater samples that were collected from monitoring wells WOC-1 and WOC-2 presented detections of arsenic, DDT, benzene hexachloride (BHC), and PCBs. Transformers have not been stored at SWMU 7 since 1976.

AOC 635 - Paint and Oil Storehouse

AOC 635 consisted of Building 3902 and was used as a paint and oil storehouse. It was built in 1942 and remained in operation until 1976 when it was removed from service. The western parking lot was also a drum storage area. The parking area was originally compacted dirt and gravel. According to the updated RFA (EnSafe/Allen & Hoshall, 1995) electrical transformers and other electrical equipment, paint wastes, plating wastes, petroleum products, solvents, corrosive materials, flammable material, poisons, oxidization agents, and combustible materials were handled at AOC 635.

SWMU 6 Summary

SWMUs 6, 7, and AOC 635 were combined into a single investigation in the RFI report (EnSafe, 1998) due to the proximity of the sites and the potential for similar chemicals of potential concern (COPCs). For the purposes of subsequent investigations, IMs, and closure, all three sites are combined and will herein be referred to as SWMU 6.

SWMU 6 was recommended for an RFI under the current RCRA permit. RFI and additional sampling locations are shown in Figure 1-3. Subsequent to the RFI, activities at SWMU 6

included the removal of buildings, concrete slabs, and parking lots. The SWMU 6 area is currently an unpaved, grassy field.

The area where SWMU 6 is located is zoned M-1, for marine industrial land use. Recently, the site has been proposed as a location for a bulk material storage facility and is expected to be used for industrial use for the foreseeable future.

1.2.2 Site History

The EBASCO RFA (1987) indicated that the SWMU 6 area was used from an unknown date until 1987 as the Public Works Storage Yard, a fenced, unpaved outdoor compound where a variety of equipment and supplies were staged and stored awaiting shipment. For a period of time prior to construction of the current hazardous waste storage facility at Building 1846, containerized hazardous wastes were stored outdoors at SWMU 6 prior to shipment. The wastes included those generated from vehicle maintenance, building maintenance, and pest control operations.

The hazardous waste storage facility operated as an Interim Status storage unit with an estimated maximum capacity of up to 2,400 55-gallon drums. An inspection by EPA in June 1986 reported that less than five drums had loose covers or damage, but none were leaking. The unit was closed in 1988 as part of the activities described in *Naval Ship Yard Charleston Closure of Interim Status Facilities*, 1988. Building 3902 was subsequently removed, and the building's concrete slab was removed during the 1998 DET soil removal IM.

1.2.3 COC Summary and Extent of Groundwater Contamination

Subsequent to completion of the IMs for soil removal (see Section 1.2.5 below), no COCs remain in site soils for the industrial land re-use scenario.

The PCB Aroclor 1254 was the only COC retained for soil under an unrestricted (residential) land use scenario, but is not a COC in site groundwater. Aroclor 1254 was detected in surface soil at boring S06-B05 during the Zone G RFI, at the location where monitoring well G006GW005 is now installed (see Figures 1-3 and 1-4). It is unclear whether the 1998 soil IM removed contaminated soil from this location. The area represented by this sample is small, and nearby delineation and post-IM soil samples had no PCB concentrations above the residential RBC.

Post-IM groundwater sampling was conducted at seven existing wells in July 2002. This sampling resulted in DDE, DDT, antimony, arsenic, iron, nickel and thallium being identified as groundwater COPCs requiring further evaluation. This 2002 sampling event

was the first time that any pesticides were detected at SWMU 6 at concentrations above tap water RBCs. After data evaluation, DDE, DDT, antimony and nickel were retained as groundwater COCs for SWMU 6. Arsenic and iron occurrence and concentrations were noted to be linked; they were eliminated as COCs because their presence together in the aquifer is most likely naturally occurring as the result of in situ iron-reducing microbial processes. However, CH2M-Jones has agreed to perform periodic groundwater monitoring for arsenic and thallium at SCHDEC's request to provide additional data on these metals in groundwater. The pesticides DDE and DDT showed some correlation to elevated turbidity (suspended solids) levels in samples, but because of the limited data available, they were retained as groundwater COCs for the CMS. Antimony and nickel were also retained as groundwater COCs.

Additional Groundwater Sampling, December 2002

To determine whether the detection of DDE and DDT in groundwater was possibly associated with elevated sample turbidity levels, groundwater was re-sampled by CH2M-Jones on December 19, 2002. Groundwater samples were collected from existing wells for pesticide and metals analysis on both filtered and unfiltered sample fractions. Low-flow sampling techniques were also utilized to reduce the turbidity of the purged water. Field parameters, including turbidity, were measured and recorded during purging and immediately prior to sampling each well.

Turbidity measurements recorded during various groundwater sampling events for the SWMU 6 monitor wells are presented in Table 1-1. As the table indicates, significant turbidity was present in five of these wells during the sampling event that occurred in July 2002. It was during this sampling event that the first detections of DDE and DDT occurred in SWMU 6 groundwater samples. The only previous detection of any DDT analog (i.e., DDT, DDE, or dichlorodiphenyldi-chloroethane [DDD]) was a detection of DDD in well G006GW005 during the May 1997 sampling event, at a concentration of 0.1 micrograms per liter (μg/L) (which is below its tap water RBC of 0.28 μg/L). Table 1-2 presents a summary of analytical results for DDD, DDE, and DDT for all SWMU 6 wells. Turbidity data are also included in this table.

The turbidity levels were much lower during the December 2002 event than during the July 2002 sampling event. A summary of analytical results for pesticides in filtered and unfiltered groundwater samples from the December 2002 sampling event is presented in Table 1-3. The data indicate that, with the exception of one detection of DDD at the

detection limit in well G006GW004, no pesticides were detected in any groundwater samples, either filtered or unfiltered.

The samples collected in December 2002 were also analyzed for the COC metals antimony and nickel, with results presented in Table 1-4. The data indicate that, with the exception of dissolved nickel detected in well G006GW005 at 7.6J $\mu g/L$ (below its tap water RBC of 73 $\mu g/L$), neither metal was detected in either filtered or unfiltered groundwater samples. Complete analytical results and data validation report information are presented in Appendix A.

These results indicate that the COCs previously identified in SWMU 6 groundwater may be adhered to fine soil particles suspended in the shallow aquifer and may not represent a true dissolved plume of contamination in site groundwater. Further monitoring will be required to better assess this potential relationship with turbidity and suspended material.

1.2.4 Summary of Hydrogeologic Setting

SWMU 6 is located in the northeastern part of Zone G, between Hobson Avenue and Pierside Street, adjacent to Pier L. The topography of the area is relatively flat, due to the extensive filling and industrial development of this area, with elevations ranging from 10 to 12 feet above mean sea level (msl) in northwestern Zone G, gently sloping downward to elevations of 6 to 8 feet above msl in eastern Zone G along the Cooper River. Because the area is highly industrialized, surface water runoff is largely controlled by a system of stormwater sewers that discharge to the Cooper River.

Surface Geology

Due to extensive soil disturbance at CNC over the history of its operation, the soils from land surface to depths of approximately 6 feet are a mixture of artificial fill and native sediments. The extent of fill material present varies widely and generally increases in thickness toward the south and east in Zone G. In the vicinity of SWMU 6, undifferentiated clay, sand, gravel, dredge spoils and construction debris may be present at or near the land surface, extending to depths of greater than 6 feet. In undisturbed areas, surface deposits consist of Quaternary age (Holocene epoch to recent) fine-grained sands, silts and clays typical of a coastal plain environment, reworked by marine and river erosion prior to development by man.

Based on boring logs for wells installed at SWMU 6, the RFI report indicated that the shallow stratigraphy at SWMU 6 generally consists of silt, silty clay, and clayey sand

overlying poorly sorted sand and silt to a depth of approximately 15 ft below land surface (bls).

Subsurface Geology

The Zone G RFI work included soil boring and monitoring well installation, from which geologic information was collected to develop geologic cross sections. These data indicate that Quaternary (Pleistocene to Holocene epoch) and Tertiary period unconsolidated sediments were the only subsurface geologic units encountered during Zone G RFI investigations.

The deepest unit identified in Zone G is the Ashley Formation, a member of the mid-Tertiary period Cooper Group. Overlying the Ashley Formation are the younger upper Tertiary and Quaternary period deposits, which are in turn overlain by the Holocene to recent surface soils.

The Ashley Formation occurs at depths of approximately 25 to 35 feet bls in Zone G. The top of the Ashley is gently rolling and slopes gently downward to the east and south, with thickness approaching 60 feet at boring location GGDG02D in northern Zone G. The Ashley Formation is comprised of brown to olive marine silts with varying amounts of clay, phosphatic sand and microfossils. The Ashley consistency is generally dense to stiff and plastic, with low vertical permeability.

In most areas of Zone G, the Ashley Formation is overlain by marine lagoon deposits consisting of undifferentiated Tertiary period silts, clays and phosphatic sands up to 20 feet in thickness.

Hydrogeology

The shallow aquifer system in Zone G is an unconfined water table aquifer occurring within the Quaternary age sediments. Depth to groundwater is approximately 3 ft bls. The underlying low-permeability Ashley Formation acts as an aquitard for the shallow aquifer system and as a confining unit for deeper geologic units. The Cooper River acts as a regional groundwater discharge boundary for the aquifer to the east. The average saturated aquifer thickness in the SWMU 6 area based on boring log data is approximately 20 feet. Because the shallow aquifer system is thinner and the Ashley confining unit is continuous across Zone G, only "shallow " monitoring wells are installed, with typical total depths of 15 to 25 feet.

Potentiometric surface data from the Zone G RFI indicate that shallow groundwater flow is generally toward the Cooper River (north to northeastward), although local variations were observed due to industrial development and also due to tidal influences near the waterfront. The drainage ditch along the east boundary of the site may also have a local effect on groundwater flow near the ditch. Horizontal hydraulic gradients in the vicinity of SWMU 6 (flow path "C" in Section 2.3.3 of the Zone G RFI Report) averaged 0.040 to 0.057 feet/foot, with average groundwater flow velocities of 0.04 to 0.05 feet per day, or approximately 15 to 20 feet per year. Figure 1-5 presents a potentiometric map of the shallow groundwater for the SWMU 6 and Zone G area of the CNC.

1.2.5 Summary of IM Results

After the RFI report and before the proposed CMS, the Navy performed an IM at SWMU 6 to remove equipment, structures, and contaminated soil with concentrations that exceeded EPA Region III residential RBCs. The DET conducted the IM in 1997 and 1998 (DET, 1998). The areas excavated are shown on Figure 1-4 . The goal of the IM was the removal of lead, PCB, and pesticide-impacted soil at the site. The target MCSs were based on the EPA Region III residential RBC values (1996) for pesticides and lead (400 milligrams per kilogram [mg/kg]). The target MCS for PCBs was the 1 mg/kg action level as specified in Title 40 Section 761.125 of the Code of Federal Regulations (40 CFR 761.125). The IM did not address the presence of benzo(a)pyrene equivalents (BEQs) at SWMU 6.

The initial scope of the DET's IM included the demolition and disposal of Building 3902, the removal and disposal of the PCB-contaminated concrete slab, the excavation and disposal of 28 cubic yards (yd^3) of PCB-contaminated soil, the excavation and disposal of 18 yd^3 of pesticide-contaminated soil, and the excavation and disposal of 90 yd^3 of lead-contaminated soil.

As the IM progressed, it became apparent from the results of the confirmation samples that the extent of contaminated soil was greater than expected. As a result, the scope of the IM was expanded. The final volume of excavated soil was estimated to be 900 yd^3. An additional 150 yd^3 of contaminated concrete was removed.

Following the removal of the approximately 1,050 yd^3 of contaminated soil and debris, confirmation sample results indicated that pesticides and PCBs were still present at concentrations above their respective target MCSs. However, the BCT concluded that the intent of the IM had been met to the extent practicable and the excavation was backfilled. A copy of the *Interim Measure Completion Report for SWMU 6, 7 & AOC 635, Charleston Naval*

Complex, Charleston SC (DET, 1998) was included in Appendix A of the RFI Report Addendum (CH2M-Jones, 2002a).

From January to July 2002, CH2M-Jones conducted pre-excavation delineation sampling and excavation of contaminated soil from several areas of SWMU 6 in order to remove soil with concentrations of COCs above the MCSs, as presented in the *Interim Measure Work Plan, Soil Removal, SWMU 6, Zone G* (CH2M-Jones, 2002b). The areas excavated are shown on Figure 1-4. The results of these investigations and details of the removal actions were presented in the IM Completion Report in Section 7.0 of the RFI Report Addendum. A summary is provided below.

The 1998 IM by the DET did not completely remove soil contaminated above residential RBCs. CH2M-Jones continued investigations to assess the feasibility of remediating surface soil to allow unrestricted land use at SWMU 6. A sampling plan was developed in January 2002 to complete RFI delineation activities and evaluate if the 1998 IM was adequate as a final remedy. The results of this investigation were reviewed, target MCSs were proposed, and additional areas with PCB, pesticide, and BEQ surface soil concentrations requiring remediation were identified (CH2M-Jones, 2002b).

CH2M-Jones performed additional investigations in May and June 2002, and refined the proposed IM removal areas and completed soil removal in June 2002. At the conclusion of the 2002 IM, an evaluation of the data was conducted to assess whether the COCs were adequately removed and cleanup objectives achieved for surface soil to levels that would allow industrial land use at this site (see Section 5.0 of the RFI Report Addendum). The results indicate that this objective was achieved.

1.3 Overall Approach for Selecting Candidate Corrective Measure Alternatives for SWMU 6

The most potentially feasible groundwater corrective measure approaches for SWMU 6, based on site conditions, limited extent of the groundwater plume, hydrogeologic setting, and previous removal of contaminated soil, are:

- Long-term Monitoring with Land Use Controls (LUCs)
- LUCs

This CMS evaluates both of these two alternatives as potential corrective measures for SWMU 6.

1.4 Report Organization

This CMS report consists of the following sections, including this introductory section:

1.0 Introduction — Presents the purpose of and background information relating to this CMS report.

2.0 Remedial Goal Objectives and Evaluation Criteria — Defines the RGOs for SWMU 6, in addition to the criteria used in evaluating the corrective measure alternatives for the site.

3.0 Description of Candidate Corrective Measure Alternatives — Describes each of the candidate corrective measure alternatives for addressing pesticides and metals in site groundwater.

4.0 Evaluation and Comparison of Corrective Measure Alternatives — Evaluates each alternative relative to standard criteria, then compares the alternatives and the degree to which they meet or achieve the evaluation criteria.

5.0 Recommended Corrective Measure Alternative — Describes the preferred corrective measure alternative to achieve the MCS and RGOs for pesticides and metals in groundwater based on a comparison of the alternatives.

6.0 References — Lists the references used in this document.

Appendix A contains Groundwater Analytical Data and Data Validation Reports.

Appendix B contains cost estimates developed for the proposed corrective measure alternatives.

Appendix C contains CH2M-Jones' responses to comments by SCDHEC on the *CMS Report, SWMU 6, Zone G, Revision 0* (October 2003).

All tables and figures appear at the end of their respective sections.

TABLE 1-1
SWMU 6 Groundwater Turbidity Data During Sample Collection
CMS Report, SWMU 6, Zone G, Charleston Naval Complex

Station ID	Sample ID	Date	Turbidity (NTU)	Volume Purged (gal)
G006GW001	006GW00101	11/14/1996	10	6.2
	006GW00102	05/14/1997	1	10.125
	006GW00103	09/18/1997	0	6.75
	006GW00104	12/02/1997	0	6.75
	006GW001M5	07/31/2002	80.2	5.8
	006GW001M6	12/19/2002	7.5	6.2
G006GW002	006GW00201	11/14/1996	9	9.5
	006GW00202	05/14/1997	10	6
	006GW00203	09/13/1997	20	10
	006GW00204	12/04/1997	8	8
	006GW002M5	07/31/2002	8	6.9
	006GW002M6	12/19/2002	10.1	5.7
G006GW003	006GW00301	11/14/1996	46	10
	006GW00302	05/15/1997	4	6
	006GW00303	09/13/1997	1	3.75
	006GW00304	12/03/1997	0	5.25
	006GW003M5	07/31/2002	10	4.8
	006GW003M6	12/19/2002	34.7	10
G006GW004	006GW00401	11/14/1996	4	4.5
	006GW00402	05/15/1997	1	6.75
	006GW00403	09/13/1997	10	11.25
	006GW00404	12/03/1997	0	6
	006GW004M5	07/31/2002	100	5.7
	006GW004M6	12/19/2002	0	6
G006GW005	006GW00501	11/14/1996	4.75	4.75
	006GW00502	05/15/1997	1	6
	006GW00503	09/13/1997	0	6
	006GW00504	12/03/1997	0	6
	006GW005M5	07/31/2002	142	5.45
	006GW005M6	12/19/2002	0	6

TABLE 1-1
SWMU 6 Groundwater Turbidity Data During Sample Collection
CMS Report, SWMU 6, Zone G, Charleston Naval Complex

Station ID	Sample ID	Date	Turbidity (NTU)	Volume Purged (gal)
G006GW006	006GW00601	11/14/1996	2	4.5
	006GW00602	05/16/1997	2	6
	006GW00603	09/18/1997	0	6
	006GW00604	12/04/1997	0	6
	006GW006M5	07/31/2002	151	5.2
	006GW006M6	12/19/2002	5.1	5.4
G006GW007	006GW00701	11/14/1996	10	6
	006GW00702	05/16/1997	2	6
	006GW00703	09/18/1997	0	6
	006GW00704	12/04/1997	0	6
	006GW007M5	07/31/2002	111	5.5
	006GW007M6	12/19/2002	0	5.7

NTU nephelometric turbidity unit
SU standard units
µS/cm micro-si+A25emens per centimeter
°C degrees Celsius
gal gallons

1

TABLE 1-2
Summary of DDD, DDE, and DDT Analytical Results for SWMU 6 Groundwater
CMS Report, SWMU 6, Zone G, Charleston Naval Complex

Station	Sample	Chem_Name	Result	Unit	Qualifier	Date_Col	Turbidity (Ntu)
G006GW001	006GW00101	p,p'-DDD	0.08000	µg/L	U	11/14/1996	10
G006GW001	006GW00101	p,p'-DDE	0.08000	µg/L	U	11/14/1996	10
G006GW001	006GW00101	p,p'-DDT	0.08000	µg/L	U	11/14/1996	10
G006GW001	006GW00102	p,p'-DDD	0.08000	µg/L	U	05/14/1997	1
G006GW001	006GW00102	p,p'-DDE	0.08000	µg/L	U	05/14/1997	1
G006GW001	006GW00102	p,p'-DDT	0.08000	µg/L	U	05/14/1997	1
G006GW001	006GW00103	p,p'-DDD	0.08000	µg/L	U	09/18/1997	0
G006GW001	006GW00103	p,p'-DDE	0.08000	µg/L	U	09/18/1997	0
G006GW001	006GW00103	p,p'-DDT	0.08000	µg/L	U	09/18/1997	0
G006GW001	006GW00104	p,p'-DDD	0.08000	µg/L	U	12/02/1997	0
G006GW001	006GW00104	p,p'-DDE	0.08000	µg/L	U	12/02/1997	0
G006GW001	006GW00104	p,p'-DDT	0.08000	µg/L	U	12/02/1997	0
G006GW001	006GW001M5	p,p'-DDD	0.08000	µg/L	U	07/31/2002	80.2
G006GW001	006GW001M5	p,p'-DDE	0.08000	µg/L	U	07/31/2002	80.2
G006GW001	006GW001M5	p,p'-DDT	0.08000	µg/L	U	07/31/2002	80.2
G006GW001	006GW001M6	p,p'-DDD	0.08200	µg/L	U	12/19/2002	7.5
G006GW001	006GW001M6	p,p'-DDE	0.08200	µg/L	U	12/19/2002	7.5
G006GW001	006GW001M6	p,p'-DDT	0.08200	µg/L	U	12/19/2002	7.5
G006GW002	006GW00201	p,p'-DDD	0.08000	µg/L	U	11/14/1996	9
G006GW002	006GW00201	p,p'-DDE	0.08000	µg/L	U	11/14/1996	9
G006GW002	006GW00201	p,p'-DDT	0.08000	µg/L	U	11/14/1996	9
G006GW002	006GW00202	p,p'-DDD	0.08000	µg/L	U	05/14/1997	10
G006GW002	006GW00202	p,p'-DDE	0.08000	µg/L	U	05/14/1997	10
G006GW002	006GW00202	p,p'-DDT	0.08000	µg/L	U	05/14/1997	10
G006GW002	006GW00203	p,p'-DDD	0.08000	µg/L	UJ	09/13/1997	20
G006GW002	006GW00203	p,p'-DDE	0.08000	µg/L	UJ	09/13/1997	20
G006GW002	006GW00203	p,p'-DDT	0.08000	µg/L	UJ	09/13/1997	20
G006GW002	006GW00204	p,p'-DDD	0.08000	µg/L	UJ	12/04/1997	8
G006GW002	006GW00204	p,p'-DDE	0.08000	µg/L	UJ	12/04/1997	8
G006GW002	006GW00204	p,p'-DDT	0.08000	µg/L	UJ	12/04/1997	8
G006GW002	006GW002M5	p,p'-DDD	0.08100	µg/L	U	07/31/2002	8
G006GW002	006GW002M5	p,p'-DDE	0.04800	µg/L	J	07/31/2002	8
G006GW002	006GW002M5	p,p'-DDT	0.28000	µg/L	=	07/31/2002	8
G006GW002	006GW002M6	p,p'-DDD	0.08000	µg/L	U	12/19/2002	10.1
G006GW002	006GW002M6	p,p'-DDE	0.08000	µg/L	U	12/19/2002	10.1
G006GW002	006GW002M6	p,p'-DDT	0.08500	µg/L	U	12/19/2002	10.1

TABLE 1-2
Summary of DDD, DDE, and DDT Analytical Results for SWMU 6 Groundwater
CMS Report, SWMU 6, Zone G, Charleston Naval Complex

Station	Sample	Chem_Name	Result	Unit	Qualifier	Date_Col	Turbidity (Ntu)
G006GW003	006GW00301	p,p'-DDD	0.08000	µg/L	U	11/14/1996	46
G006GW003	006GW00301	p,p'-DDE	0.08000	µg/L	U	11/14/1996	46
G006GW003	006GW00301	p,p'-DDT	0.08000	µg/L	U	11/14/1996	46
G006GW003	006GW00302	p,p'-DDD	0.08000	µg/L	U	05/15/1997	4
G006GW003	006GW00302	p,p'-DDE	0.08000	µg/L	U	05/15/1997	4
G006GW003	006GW00302	p,p'-DDT	0.08000	µg/L	U	05/15/1997	4
G006GW003	006GW00303	p,p'-DDD	0.08000	µg/L	UJ	09/13/1997	1
G006GW003	006GW00303	p,p'-DDE	0.08000	µg/L	UJ	09/13/1997	1
G006GW003	006GW00303	p,p'-DDT	0.08000	µg/L	UJ	09/13/1997	1
G006GW003	006GW00304	p,p'-DDD	0.08000	µg/L	U	12/03/1997	0
G006GW003	006GW00304	p,p'-DDE	0.08000	µg/L	U	12/03/1997	0
G006GW003	006GW00304	p,p'-DDT	0.08000	µg/L	U	12/03/1997	0
G006GW003	006GW003M5	p,p'-DDD	0.08300	µg/L	U	07/31/2002	10
G006GW003	006GW003M5	p,p'-DDE	0.25000	µg/L	=	07/31/2002	10
G006GW003	006GW003M5	p,p'-DDT	1.50000	µg/L	=	07/31/2002	10
G006GW003	006GW003M6	p,p'-DDD	0.08200	µg/L	U	12/19/2002	34.7
G006GW003	006GW003M6	p,p'-DDE	0.08200	µg/L	U	12/19/2002	34.7
G006GW003	006GW003M6	p,p'-DDT	0.08200	µg/L	U	12/19/2002	34.7
G006GW004	006GW00401	p,p'-DDD	0.08000	µg/L	U	11/14/1996	4
G006GW004	006GW00401	p,p'-DDE	0.08000	µg/L	U	11/14/1996	4
G006GW004	006GW00401	p,p'-DDT	0.08000	µg/L	U	11/14/1996	4
G006GW004	006GW00402	p,p'-DDD	0.08000	µg/L	UJ	05/15/1997	1
G006GW004	006GW00402	p,p'-DDE	0.08000	µg/L	UJ	05/15/1997	1
G006GW004	006GW00402	p,p'-DDT	0.08000	µg/L	UJ	05/15/1997	1
G006GW004	006GW00403	p,p'-DDD	0.08000	µg/L	U	09/13/1997	10
G006GW004	006GW00403	p,p'-DDE	0.08000	µg/L	U	09/13/1997	10
G006GW004	006GW00403	p,p'-DDT	0.08000	µg/L	U	09/13/1997	10
G006GW004	006GW00404	p,p'-DDD	0.08000	µg/L	UJ	12/03/1997	0
G006GW004	006GW00404	p,p'-DDE	0.08000	µg/L	UJ	12/03/1997	0
G006GW004	006GW00404	p,p'-DDT	0.08000	µg/L	UJ	12/03/1997	0
G006GW004	006GW004M5	p,p'-DDD	0.40000	µg/L	U	07/31/2002	100
G006GW004	006GW004M5	p,p'-DDE	2.20000	µg/L	=	07/31/2002	100
G006GW004	006GW004M5	p,p'-DDT	1.80000	µg/L	=	07/31/2002	100
G006GW004	006GW004M6	p,p'-DDD	0.08300	µg/L	U	12/19/2002	0
G006GW004	006GW004M6	p,p'-DDE	0.08300	µg/L	U	12/19/2002	0
G006GW004	006GW004M6	p,p'-DDT	0.08300	µg/L	U	12/19/2002	0
G006GW005	006GW00501	p,p'-DDD	0.08000	µg/L	UJ	11/14/1996	4.75
G006GW005	006GW00501	p,p'-DDE	0.08000	µg/L	UJ	11/14/1996	4.75

TABLE 1-2
Summary of DDD, DDE, and DDT Analytical Results for SWMU 6 Groundwater
CMS Report, SWMU 6, Zone G, Charleston Naval Complex

Station	Sample	Chem_Name	Result	Unit	Qualifier	Date_Col	Turbidity (Ntu)
G006GW005	006GW00501	p,p'-DDT	0.08000	µg/L	UJ	11/14/1996	4.75
G006GW005	006GW00502	p,p'-DDD	0.10000	µg/L	=	05/15/1997	1
G006GW005	006GW00502	p,p'-DDE	0.08000	µg/L	U	05/15/1997	1
G006GW005	006GW00502	p,p'-DDT	0.08000	µg/L	U	05/15/1997	1
G006GW005	006GW00503	p,p'-DDD	0.08000	µg/L	UJ	09/13/1997	0
G006GW005	006GW00503	p,p'-DDE	0.08000	µg/L	UJ	09/13/1997	0
G006GW005	006GW00503	p,p'-DDT	0.08000	µg/L	UJ	09/13/1997	0
G006GW005	006GW00504	p,p'-DDD	0.08000	µg/L	UJ	12/04/1997	0
G006GW005	006GW00504	p,p'-DDE	0.08000	µg/L	UJ	12/04/1997	0
G006GW005	006GW00504	p,p'-DDT	0.08000	µg/L	UJ	12/04/1997	0
G006GW005	006GW005M5	p,p'-DDD	0.09500	µg/L	=	07/31/2002	142
G006GW005	006GW005M5	p,p'-DDE	0.08000	µg/L	U	07/31/2002	142
G006GW005	006GW005M5	p,p'-DDT	0.08000	µg/L	U	07/31/2002	142
G006GW005	006GW005M6	p,p'-DDD	0.08300	µg/L	J	12/19/2002	0
G006GW005	006GW005M6	p,p'-DDE	0.08700	µg/L	U	12/19/2002	0
G006GW005	006GW005M6	p,p'-DDT	0.08700	µg/L	U	12/19/2002	0
G006GW006	006GW00601	p,p'-DDD	0.08000	µg/L	UJ	11/14/1996	2
G006GW006	006GW00601	p,p'-DDE	0.08000	µg/L	UJ	11/14/1996	2
G006GW006	006GW00601	p,p'-DDT	0.08000	µg/L	UJ	11/14/1996	2
G006GW006	006GW00602	p,p'-DDD	0.08000	µg/L	UJ	05/16/1997	2
G006GW006	006GW00602	p,p'-DDE	0.08000	µg/L	UJ	05/16/1997	2
G006GW006	006GW00602	p,p'-DDT	0.08000	µg/L	UJ	05/16/1997	2
G006GW006	006GW00603	p,p'-DDD	0.08000	µg/L	U	09/18/1997	0
G006GW006	006GW00603	p,p'-DDE	0.08000	µg/L	U	09/18/1997	0
G006GW006	006GW00603	p,p'-DDT	0.08000	µg/L	U	09/18/1997	0
G006GW006	006GW00604	p,p'-DDD	0.08000	µg/L	UJ	12/04/1997	0
G006GW006	006GW00604	p,p'-DDE	0.08000	µg/L	UJ	12/04/1997	0
G006GW006	006GW00604	p,p'-DDT	0.08000	µg/L	UJ	12/04/1997	0
G006GW006	006GW006M5	p,p'-DDD	0.08000	µg/L	U	07/31/2002	151
G006GW006	006GW006M5	p,p'-DDE	0.26000	µg/L	=	07/31/2002	151
G006GW006	006GW006M5	p,p'-DDT	0.43000	µg/L	=	07/31/2002	151
G006GW006	006GW006M6	p,p'-DDD	0.08000	µg/L	U	12/19/2002	5.1
G006GW006	006GW006M6	p,p'-DDE	0.08000	µg/L	U	12/19/2002	5.1
G006GW006	006GW006M6	p,p'-DDT	0.08000	µg/L	U	12/19/2002	5.1
G006GW007	006GW00701	p,p'-DDD	0.08000	µg/L	U	11/14/1996	10
G006GW007	006GW00701	p,p'-DDE	0.08000	µg/L	U	11/14/1996	10
G006GW007	006GW00701	p,p'-DDT	0.08000	µg/L	U	11/14/1996	10
G006GW007	006GW00702	p,p'-DDD	0.08000	µg/L	UJ	05/16/1997	2

TABLE 1-2
Summary of DDD, DDE, and DDT Analytical Results for SWMU 6 Groundwater
CMS Report, SWMU 6, Zone G, Charleston Naval Complex

Station	Sample	Chem_Name	Result	Unit	Qualifier	Date_Col	Turbidity (Ntu)
G006GW007	006GW00702	p,p'-DDE	0.08000	µg/L	UJ	05/16/1997	2
G006GW007	006GW00702	p,p'-DDT	0.08000	µg/L	UJ	05/16/1997	2
G006GW007	006GW00703	p,p'-DDD	0.08000	µg/L	U	09/18/1997	0
G006GW007	006GW00703	p,p'-DDE	0.08000	µg/L	U	09/18/1997	0
G006GW007	006GW00703	p,p'-DDT	0.08000	µg/L	U	09/18/1997	0
G006GW007	006GW00704	p,p'-DDD	0.08000	µg/L	UJ	12/04/1997	0
G006GW007	006GW00704	p,p'-DDE	0.08000	µg/L	UJ	12/04/1997	0
G006GW007	006GW00704	p,p'-DDT	0.08000	µg/L	UJ	12/04/1997	0
G006GW007	006GW007M5	p,p'-DDD	0.08200	µg/L	U	07/31/2002	111
G006GW007	006GW007M5	p,p'-DDE	0.72000	µg/L	=	07/31/2002	111
G006GW007	006GW007M5	p,p'-DDT	1.20000	µg/L	=	07/31/2002	111
G006GW007	006GW007M6	p,p'-DDD	0.08300	µg/L	U	12/19/2002	0
G006GW007	006GW007M6	p,p'-DDE	0.08300	µg/L	U	12/19/2002	0
G006GW007	006GW007M6	p,p'-DDT	0.08300	µg/L	U	12/19/2002	0

TABLE 1-3
Analytical Results for COC Pesticides in Groundwater, December 19, 2002
CMS Report, SWMU 6, Zone G, Charleston Naval Complex

Sample Location	Analyte	Concentration, µg/L	Qualifier
G006GW001	p,p'-DDD	0.082	U
	p,p'-DDD, Dissolved	0.084	U
	p,p'-DDE	0.082	U
	p,p'-DDE, Dissolved	0.084	U
	p,p'-DDT	0.082	U
	p,p'-DDT, Dissolved	0.084	U
G006GW002	p,p'-DDD	0.08	U
	p,p'-DDD, Dissolved	0.084	U
	p,p'-DDE	0.08	U
	p,p'-DDE, Dissolved	0.084	U
	p,p'-DDT	0.085	U
	p,p'-DDT, Dissolved	0.084	U
G006GW003	p,p'-DDD	0.082	U
	p,p'-DDD, Dissolved	0.085	U
	p,p'-DDE	0.082	U
	p,p'-DDE, Dissolved	0.085	U
	p,p'-DDT	0.082	U
	p,p'-DDT, Dissolved	0.085	U
G006GW004	p,p'-DDD	0.084	U
	p,p'-DDD	0.083	U
	p,p'-DDD, Dissolved	0.085	U
	p,p'-DDD, Dissolved	0.083	U
	p,p'-DDE	0.084	U
	p,p'-DDE	0.083	U
	p,p'-DDE, Dissolved	0.085	U
	p,p'-DDE, Dissolved	0.083	U
	p,p'-DDT	0.084	U
	p,p'-DDT	0.083	U
	p,p'-DDT, Dissolved	0.085	U
	p,p'-DDT, Dissolved	0.083	U
G006GW005	p,p'-DDD	0.083	J
	p,p'-DDD, Dissolved	0.084	U
	p,p'-DDE	0.087	U
	p,p'-DDE, Dissolved	0.084	U
	p,p'-DDT	0.087	U
	p,p'-DDT, Dissolved	0.084	U
G006GW006	p,p'-DDD	0.08	U
	p,p'-DDD, Dissolved	0.084	U
	p,p'-DDE	0.08	U
	p,p'-DDE, Dissolved	0.084	U
	p,p'-DDT	0.08	U
	p,p'-DDT, Dissolved	0.084	U
G006GW007	p,p'-DDD	0.083	U
	p,p'-DDD, Dissolved	0.084	U
	p,p'-DDE	0.083	U
	p,p'-DDE, Dissolved	0.084	U
	p,p'-DDT	0.083	U
	p,p'-DDT, Dissolved	0.084	U

TABLE 1-4
Analytical Results for COC Metals in Groundwater, December 19, 2002
CMS Report, SWMU 6, Zone G, Charleston Naval Complex

Sample Location	Analyte	Concentration, µg/L	Qualifier
G006GW001	Antimony, Dissolved	6.61	U
	Antimony	6.61	U
G006GW002	Antimony, Dissolved	6.61	U
	Antimony	6.61	U
G006GW003	Antimony, Dissolved	6.61	U
	Antimony	6.61	U
G006GW004	Antimony, Dissolved	6.61	U
	Antimony, Dissolved	6.61	U
	Antimony	6.61	U
	Antimony	6.61	U
G006GW005	Antimony, Dissolved	6.61	U
	Antimony	6.61	U
G006GW006	Antimony, Dissolved	6.61	U
	Antimony	6.61	U
G006GW007	Antimony, Dissolved	6.61	U
	Antimony	6.61	U
G006GW001	Nickel	1.02	U
	Nickel, Dissolved	1.72	U
G006GW002	Nickel	51	U
	Nickel, Dissolved	51	U
G006GW003	Nickel	1.02	U
	Nickel, Dissolved	1.02	U
G006GW004	Nickel	1.02	U
	Nickel	1.02	U
	Nickel, Dissolved	1.02	U
	Nickel, Dissolved	1.02	U
G006GW005	Nickel	5.99	U
	Nickel, Dissolved	7.67	J
G006GW006	Nickel	1.02	U
	Nickel, Dissolved	1.02	U
G006GW007	Nickel	1.02	U
	Nickel, Dissolved	1.02	U

U Indicates that the analyte was analyzed for but not detected above the method detection limit.
J Indicates that the concentration shown is estimated.
µg/L micrograms per liter

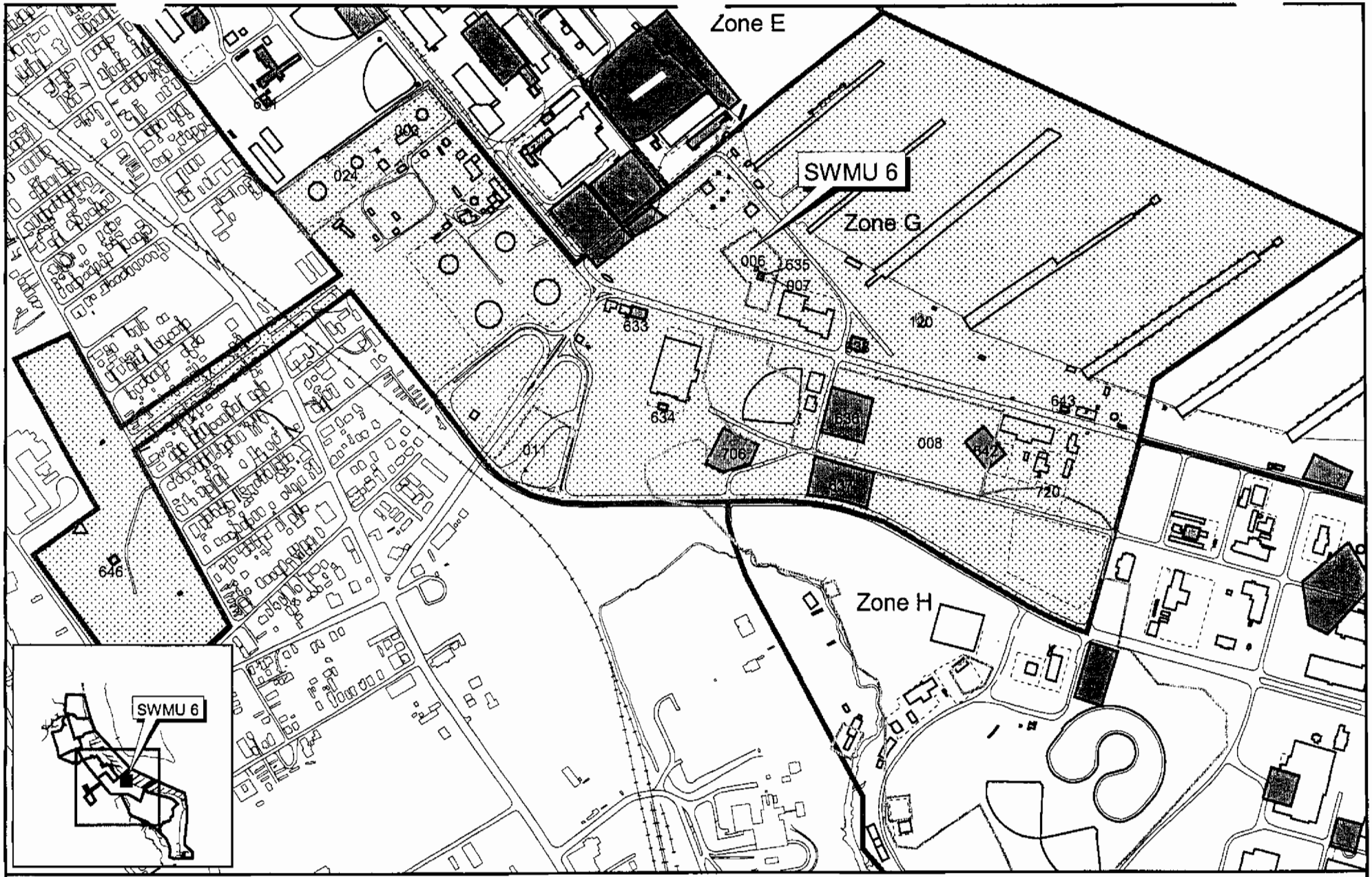

Figure 1-1
SWMU 6, Zone G
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_g\zoneg_locationfig.apr, Date: 29 Jul 2002 7:39, User: NMOUDRY, Figure 1-1 Zone G within CNC

SWMU / AOC
Buildings
Zone Boundary

N

0 80 160 Feet

1 inch = 100 feet

Figure 1-2
Aerial View
SWMU 6, Zone G
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_g\zoneg_locationfig.apr, Date: 29 Jul 2002 7:46, User: NMOUDRY, Figure 1-2 Site Location

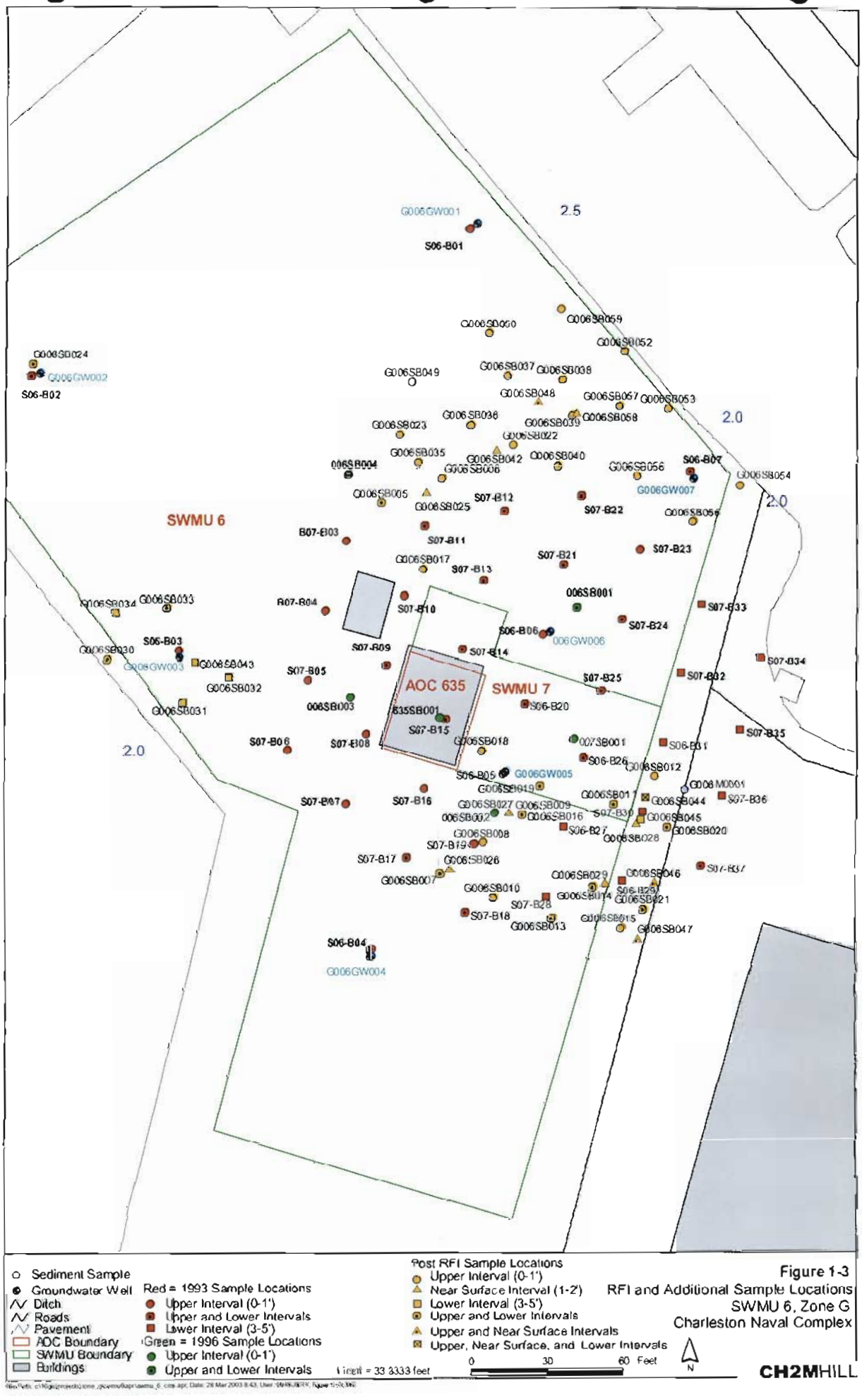

Figure 1-3
RFI and Additional Sample Locations
SWMU 6, Zone G
Charleston Naval Complex

CH2MHILL

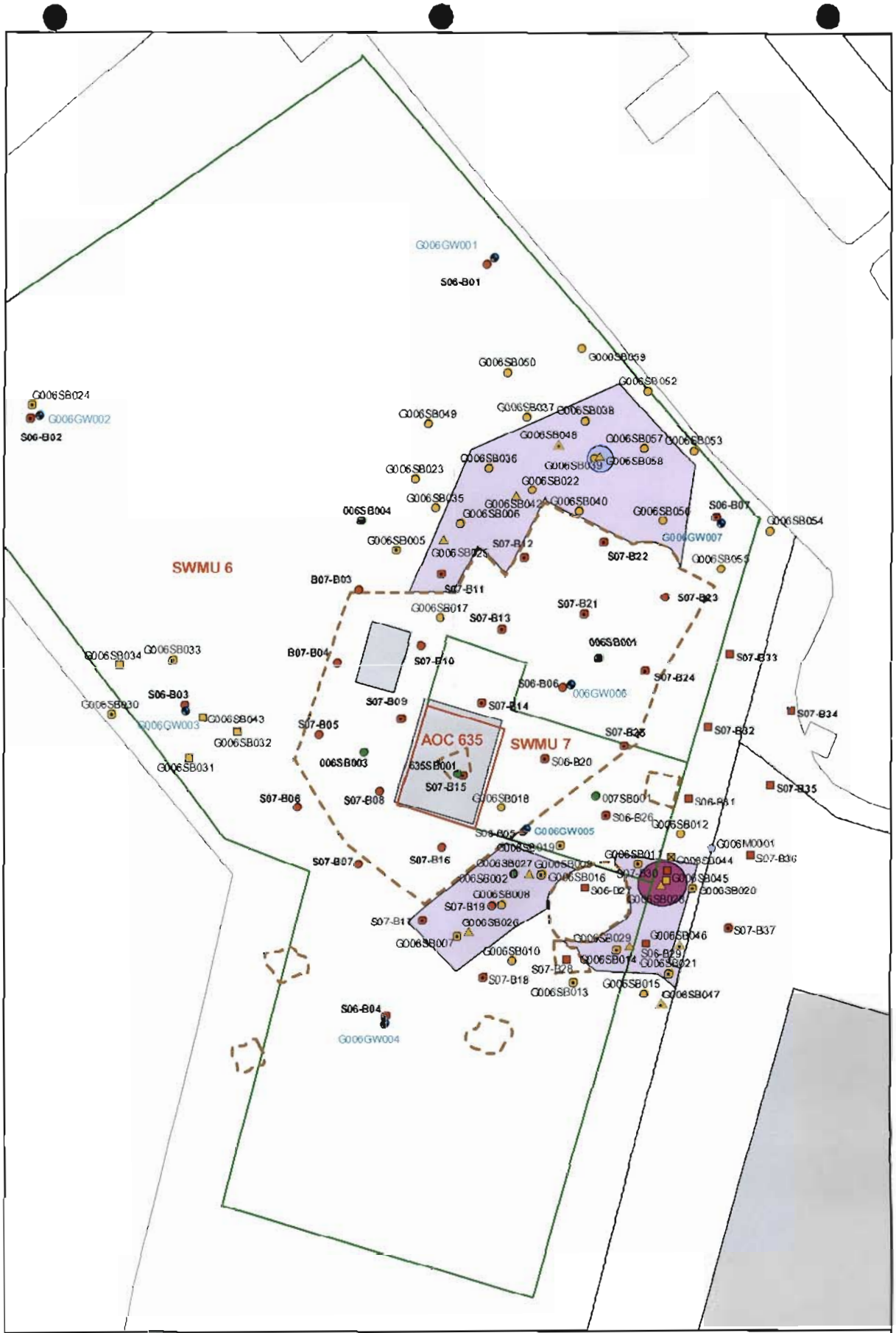

Figure 1-4
IM Sampling and Excavation Locations
SWMU 6, Zone G
Charleston Naval Complex

NOTE: Original figure created in color

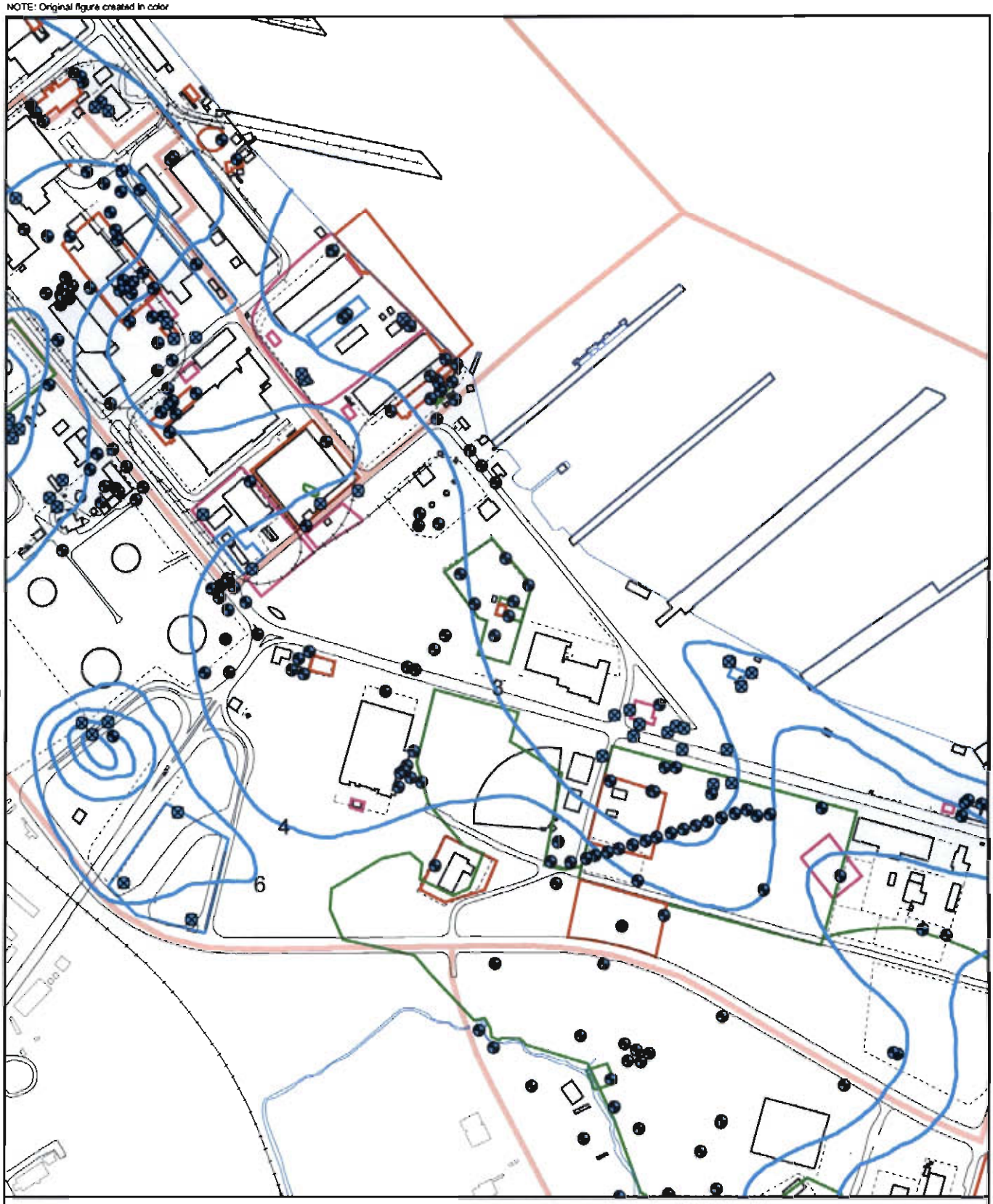

Figure 1-5
Potentiometric Surface
SWMU 6
Charleston Naval Complex

File Path: c:\18gis\cn\cnc-egis.apr, Date: 03 Oct 2003 11:00, User: DWILLIAM, EGIS: Charleston Naval Complex - Figure 1-5 Potentiometric Surface

Section 2.0

2.0 Remedial Goal Objectives and Evaluation Criteria

2.1 Remedial Action Objectives

RAOs are medium-specific goals that protect human health and the environment by preventing or reducing exposures under current and future land use conditions. The RAOs identified for the groundwater at SWMU 6 are to:

1) Prevent ingestion and direct/dermal contact with groundwater having unacceptable non-carcinogenic risk;

2) Prevent migration to offsite areas; and

3) Restore the aquifer to its beneficial use.

2.2 Remedial Goal Options an Media Cleanup Standards

Typically after RAOs have been established and the risk assessment is complete, RGOs are developed for each RAO. The RGOs are based on assumptions about a particular land use scenario and include different residual risk levels for comparison. For example, to remediate surface soils to protect an onsite maintenance worker, RGOs might include remediating to anthropogenic background levels or to one of a variety of specific risk levels (such as 1E-06 or 1E-04). For each RGO, a specific MCS is determined for specific chemicals. These MCSs are expressed in conventional concentration units, such as milligrams per kilogram (mg/kg) or mg/L, for specific chemicals.

RGOs and MCSs can be based on a variety of criteria, such as drinking water maximum contaminant levels (MCLs), specific incremental lifetime cancer risk (ILCR) target levels (e.g., 1E-04, 1E-05, or 1E-06), target Hazard Index (HI) levels (e.g., 0.1, 1.0, 3.0), or site background concentrations. For a particular RGO, specific MCSs can be determined as target concentration values that the selected alternative is required to achieve. Achieving these goals should protect human health and the environment, while achieving compliance with applicable state and federal standards. Remediating the site to those specific MCSs would be suitable to demonstrate that the RAO has been achieved.

The exposure media of concern and COCs for SWMU 6 are surface soil (Aroclor 1254, for unrestricted land use scenario) and shallow groundwater (DDE, DDT, antimony and nickel).

For achieving concentrations that would be suitable for unrestricted land use, the proposed MCS for Aroclor 1254 is the residential RBC of 0.32 mg/kg.

Proposed MCSs for groundwater COCs are the EPA Drinking Water Standards (MCLs), or for those COCs that do not have an MCL, the EPA Region III tap water RBC. The table below presents these COCs and their respective proposed MCSs.

Chemical	EPA Drinking Water MCL (µg/L)	RBC (µg/L)
DDE	NA	0.2
DDT	NA	0.2
Antimony	6	NA
Nickel	NA	73

2.3 Evaluation Criteria

According to the EPA RCRA CA guidance, corrective measure alternatives should be evaluated using the following five criteria:

1. Protection of human health and the environment.
2. Attainment of MCSs.
3. The control of the source of releases to minimize future releases that may pose a threat to human health and the environment.
4. Compliance with applicable standards for the management of wastes generated by remedial activities.
5. Other factors, including (a) long-term reliability and effectiveness; (b) reduction in toxicity, mobility, or volume of wastes; (c) short-term effectiveness; (d) implementability; and (e) cost.

Each of these criteria is defined in more detail below:

1. **Protection of human health and the environment.** The alternatives will be evaluated on the basis of their ability to protect human health and the environment. The ability of an alternative to achieve this criterion may or may not be independent of its ability to

achieve the other criteria. For example, an alternative may be protective of human health, but may not be able to attain the MCSs if the MCSs were not developed based on human health protection factors.

2. **Attainment of MCSs.** The alternatives will be evaluated on the basis of their ability to achieve the MCS defined in this CMS. Another aspect of this criterion is the time frame required to achieve the MCS. Estimates of the time frame for the alternatives to achieve RGOs will be provided.

3. **The control the source of releases.** This criterion deals with the control of releases of contamination from the source (the area in which the contamination originated) and the prevention of future migration to uncontaminated areas.

4. **Compliance with applicable standards for management of wastes.** This criterion deals with the management of wastes derived from implementing the alternatives (i.e., treatment or disposal of VOC-contaminated residuals from groundwater treatment processes). Corrective measure alternatives will be designed to comply with all standards for management of wastes. Consequently, this criterion will not be explicitly included in the detailed evaluation presented in the CMS, but such compliance would be incorporated into the cost estimates for which this criterion is relevant.

5. **Other factors.** Five other factors are to be considered if an alternative is found to meet the four criteria described above. These other factors are as follows:

    a. Long-term reliability and effectiveness

    Corrective measure alternatives will be evaluated on the basis of their reliability, and the potential impact should the alternative fail. In other words, a qualitative assessment will be made as to the chance of the alternative's failing and the consequences of that failure.

    b. Reduction in the toxicity, mobility, or volume of wastes

    Alternatives with technologies that reduce the toxicity, mobility, or volume of the contamination will be generally favored over those that do not. Consequently, a qualitative assessment of this factor will be performed for each alternative.

    c. Short-term effectiveness

    Alternatives will be evaluated on the basis of the risk they create during the implementation of the remedy. Factors that may be considered include fire, explosion, and exposure of workers to hazardous substances.

d. Implementability

The alternatives will be evaluated for their implementability by considering any difficulties associated with conducting the alternatives (such as the construction disturbances they may create), operation of the alternatives, and the availability of equipment and resources to implement the technologies comprising the alternatives.

e. Cost

A net present value of each alternative will be developed. These cost estimates will be used for the relative evaluation of the alternatives, not to bid or budget the work. The estimates will be based on information available at the time of the CMS and on a conceptual design of the alternative. They will be "order-of-magnitude" estimates with a generally expected accuracy of -50 percent to +100 percent for the scope of action described for each alternative. The estimates will be categorized into capital costs and operations and maintenance costs for each alternative.

Section 3.0

3.0 Description of Candidate Corrective Measure Alternatives

3.1 Introduction

Currently available groundwater remediation technologies were screened for applicability to the contaminants and site conditions present at SWMU 6. Detailed analyses of selected technologies presented in Section 4.0 provide the rationale to support selection of the recommended corrective measure alternative. Two candidate corrective measure alternatives were selected for this site:

- Alternative 1: Long-term Monitoring with LUCs
- Alternative 2: LUCs

The sections below describe each selected alternative in more detail.

3.2 Alternative 1: Long-term Monitoring with LUCs

3.2.1 Description of Alternative

This alternative would involve periodic groundwater sampling to further characterize concentrations of the COCs in groundwater and assess changes in groundwater quality over time. As noted in Section 1.0, the detections of the pesticide and metal COCs may be related to high turbidity levels encountered in the wells during the July 2002 sampling event. Prior to the July 2002 sampling event, the wells had not been sampled since 1997. It is possible that over the 5 intervening years between the 1997 and July 2002 sampling events, sediment accumulated in the wells, which impacted the July 2002 results. In contrast, the sampling in December 2002 did not indicate any groundwater COC exceedances of the target MCSs. Thus, continued monitoring may reveal that a groundwater plume is not truly present at the site.

The source of contamination has been removed from SWMU 6. The removal of significant amounts of pesticide-impacted soil removed from the site during the IMs completed at SWMU 6 is expected to result in a beneficial effect on groundwater quality over time. With the source removed, natural attenuation processes, such as dispersion, dilution, and adsorption, are expected to mitigate any groundwater contaminants that may be present and allow groundwater concentrations to achieve the target MCSs over time. Because these

natural attenuation processes do not rely on biological processes, monitoring for typical MNA parameters is not necessary. Monitoring for filtered and unfiltered pesticides for several periods should be adequate to confirm that the expected attenuation is occurring.

Subsequent to submitting the Revision 0 version of this CMS report, several additional surface soil samples were collected from the vicinity of monitoring well G006GW005, where an elevated detection of Aroclor 1254 was earlier reported. The results of this additional sampling, submitted with the Response To Comments for this report (See Appendix C) demonstrated that elevated Aroclor and PCB concentrations were not present in this area. Therefore, it was concluded that Aroclor 1254 should not be retained as a surface soil COC for the industrial or unrestricted land use scenario.

During the period while the groundwater monitoring is ongoing and COCs are still identified at the site, LUCs will also be applied. The LUCs will limit the site to industrial land use only and provide for groundwater use restrictions such that no unacceptable exposure of receptors to site contaminants occurs.

3.2.2 Uncertainties

No significant uncertainties are associated with this alternative.

3.2.3 Other Considerations

No other considerations were identified for this alternative.

3.3 Alternative 2: LUCs

3.3.1 Description of Alternative

This alternative would involve the implementation of LUCs alone as the remedy. The LUCs would limit the site to industrial land use only and provide groundwater use restrictions such that no unacceptable exposure of receptors to site contaminants occurs.

3.3.2 Key Uncertainties

The key uncertainty for this alternative is the degree to which groundwater contamination is present or due to turbidity. Although the data collected suggest that the groundwater contamination may be related to turbidity, additional data are needed to confirm this relationship. However, even if the groundwater COCs are present as a small plume, the removal of the contaminated soil, combined with natural attenuation processes, is expected

to mitigate the plume and allow groundwater concentrations to eventually achieve the target MCSs.

3.3.3 Other Considerations

No other considerations were noted for this alternative.

Section 4.0

4.0 Evaluation and Comparison of Corrective Measure Alternatives

The two corrective measure alternatives were evaluated relative to the evaluative criteria previously described in Section 2.0, and then subjected to a comparative evaluation. A cost estimate for each alternative was also developed; the assumptions and unit costs used for these estimates are included in Appendix B.

4.1 Alternative 1: Long-term Monitoring with LUCs

Assumptions for Alternative 1 include the following:

- Five monitoring wells would be sampled on an annual basis for groundwater COCs for up to 5 years to demonstrate that the plume is either associated with turbidity or until natural attenuation processes indicate that an adequate decrease in COC concentrations has occurred.
- Surface soil samples will be collected near well G006GW005 and analyzed for PCBs to determine whether Aroclor 1254 needs to be retained as a surface soil COC for unrestricted land use.
- A base-wide LUCIP will be developed for the CNC. The LUCIP will allow for restrictions on land use and groundwater use at SWMU 6 and will be developed outside the scope of this CMS.

4.1.1 Protection of Human Health and the Environment

Alternative 1 would be effective at protecting human health and the environment because the LUCs will preclude unacceptable exposure of receptors to COCs from occurring.

4.1.2 Attain MCS

Alternative 1 is expected to eventually achieve the target MCSs for groundwater. With the source removed, natural attenuation processes will act to mitigate groundwater COC concentrations.

4.1.3 Control the Source of Releases

The source of release has been removed from the site through the various IMs that have removed contaminated soil.

4.1.4 Compliance with Applicable Standards for the Management of Generated Wastes

Alternative 1 does not generate any wastes that would require special management. Only purge water from well sampling is expected to be generated.

4.1.5 Other Factors (a) Long-term Reliability and Effectiveness

Alternative 1 provides a level of protection that has long-term reliability and effectiveness. The risk of failure is low, provided the LUCs are enforced.

4.1.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes

Natural attenuation processes are expected to reduce the volume and mobility of groundwater contaminants over time.

4.1.7 Other Factors (c) Short-term Effectiveness

Alternative 1 would be effective in the short term due to the implementation of LUCs.

4.1.8 Other Factors (d) Implementability

Alternative 1 is easily implemented. No construction is needed to begin implementation.

4.1.9 Other Factors (e) Cost.

Using the assumptions described earlier, the total present value of Alternative 1 is $54,000.

4.2 Alternative 2:

The assumptions for Alternative 2 include the following:

- A base-wide LUCIP will be developed for the CNC. The plan will allow for restrictions on land use and groundwater use at SWMU 6 and will be developed outside the scope of this CMS.

4.2.1 Protection of Human Health and the Environment

Alternative 2 would be effective at protecting human health and the environment because through LUCs, it precludes unacceptable exposure of receptors to COCs.

4.2.2 Attain MCS

Alternative 2 is expected to eventually achieve the target MCSs for groundwater. However, no monitoring to confirm that the MCSs have been obtained is included with this alternative.

4.2.3 Control the Source of Releases

The source of release has been removed from the site through the various IMs that have removed contaminated soil.

4.2.4 Compliance with Applicable Standards for the Management of Generated Wastes

Alternative 2 does not generate any wastes that would require special management.

4.2.5 Other Factors (a) Long-term Reliability and Effectiveness

Alternative 2 provides a level of protection that has long-term reliability and effectiveness. The risk of failure is low, provided the LUCs are enforced.

4.2.6 Other Factors (b) Reduction in the Toxicity, Mobility, or Volume of Wastes

Natural attenuation processes are expected to reduce the volume and mobility of groundwater contaminants over time.

4.2.7 Other Factors (c) Short-term Effectiveness

Alternative 2 would be effective in the short term due to the implementation of LUCs.

4.2.8 Other Factors (d) Implementability

Alternative 2 is easily implemented. No construction is needed to begin implementation.

4.2.9 Other Factors (e) Cost

Using the assumptions listed above, the total present value of Alternative 2 is $20,000.

4.4 Comparative Ranking of Corrective Measure Alternatives

Each corrective measure alternative's overall ability to meet the evaluation criteria is described above. In Table 4-1, a comparative evaluation of the degree to which each alternative meets a particular criteria is presented.

TABLE 4-1
Ranking of Corrective Measure Alternatives
Corrective Measures Study Report, SWMU 6, Zone G, Charleston Naval Complex

Criterion	Alternative 1 Long-term Monitoring with LUCs	Alternative 2 LUCs
Overall Protection of Human Health and the Environment	This alternative is protective of human health and the environment.	This alternative is protective of human health and the environment.
Attainment of MCS	This alternative is expected to eventually achieve the MCSs.	This alternative is expected to eventually achieve the MCS. However, no monitoring to confirm this is included in this alternative.
Control of the source of releases	The source of releases have been removed from the site.	The source of releases have been removed from the site.
Compliance with applicable standards for the management of wastes	This alternative can be implemented in a manner that meets all applicable waste management standards.	This alternative can be implemented in a manner that meets all applicable waste management standards.
Long-term Reliability and Effectiveness	This alternative will have long-term reliability and effectiveness.	This alternative will have long-term reliability and effectiveness.
Reduction of Toxicity, Mobility, or Volume through Treatment	Natural attenuation processes will reduce the mobility and volume of contaminated groundwater over time.	Natural attenuation processes will reduce the mobility and volume of contaminated groundwater over time.
Short-term Effectiveness	This alternative will be effective in the short term.	This alternative will be effective in the short term.
Implementability	This alternative is easily implemented.	This alternative is easily implemented.
Estimated Cost	$54,000	$20,000

Section 5.0

5.0 Recommended Corrective Measure Alternative

Two corrective measure alternatives were evaluated using the criteria described in Section 2.0 of this CMS report: (1) Alternative 1: Long-term Monitoring with LUCs, and (2) Alternative 2: LUCs. Based on the evaluation of these two alternatives, the preferred corrective measure alternative is Alternative 1: Long-term Monitoring with LUCs. This remedy would be protective at a reasonable cost.

Alternative 1 would protect human health and the environment by maintaining the current and planned future use of the site as industrial/commercial, until the issues regarding the current concentrations of Aroclor 1254 in surface soil are resolved. Limitations would prevent residential and other unrestricted land use that could expose sensitive populations. Groundwater use restrictions would also be imposed to restrict use of groundwater until the groundwater COCs have been found to be below the target MCSs.

Planning is already underway to develop and implement administrative controls that would limit future site activities to those that would not involve unrestricted exposures. The expected reliability of this alternative is good.

There are no community safety issues associated with implementation of this remedy, and the controls would be relatively easy to implement. This alternative provides long-term effectiveness for the planned industrial/commercial use, and relies on administrative controls to prevent future residential use.

Section 6.0

6.0 References

CH2M-Jones. *RFI Report Addendum, IM Completion Report (IMCR), and Corrective Measures Study (CMS) Work Plan for SWMU 6, Zone G.* Revision 0. 2002a.

CH2M-Jones. *Interim Measure Work Plan, Soil Removal, SWMU 6, Zone G.* 2002b.

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EnSafe Inc. *Zone G RFI Report, NAVBASE Charleston.* Revision 0. February 1998.

Freeze, R. Allen and John A. Cherry. *Groundwater.* Prentice Hall, Inc. 1979.

South Carolina Department of Health and Environmental Control (SCDHEC). RCRA Permit SC0 170 022 560. Charleston Naval Complex, Charleston, South Carolina. August 17, 1988.

South Carolina Department of Health and Environmental Control (SCDHEC). Comments on *Zone F RFI Report, Revision 0.* December 31, 1998.

Appendix A

	StationID	G006GW001		G006GW002		G006GW003	
	SampleID	006GW001M6		006GW002M6		006GW003M6	
	DateCollected	12/19/2002		12/19/2002		12/19/2002	
	DateExtracted	12/20/2002		12/20/2002		12/20/2002	
	DateAnalyzed	12/23/2002		12/23/2002		12/23/2002	
	SDGNumber	72452		72452		72452	
Parameter	**Units**						
Aldrin	ug/L	0.041	U	0.04	U	0.041	U
Alpha BHC (Alpha Hexachlorocyclohexane)	ug/L	0.041	U	0.04	U	0.041	U
Alpha-chlordane	ug/L	0.041	U	0.04	U	0.041	U
Beta BHC (Beta Hexachlorocyclohexane)	ug/L	0.041	U	0.04	U	0.041	U
Chlordane	ug/L	0.41	U	0.4	U	0.41	U
Delta BHC (Delta Hexachlorocyclohexane)	ug/L	0.041	U	0.04	U	0.041	U
Dieldrin	ug/L	0.082	U	0.08	U	0.082	U
Endosulfan I	ug/L	0.041	U	0.04	U	0.041	U
Endosulfan II	ug/L	0.082	U	0.08	U	0.082	U
Endosulfan Sulfate	ug/L	0.082	U	0.08	U	0.082	U
Endrin Aldehyde	ug/L	0.082	U	0.08	U	0.082	U
Endrin Ketone	ug/L	0.082	U	0.08	U	0.082	U
Endrin	ug/L	0.082	U	0.08	U	0.082	U
Gamma BHC (Lindane)	ug/L	0.041	U	0.04	U	0.041	U
Gamma-chlordane	ug/L	0.041	U	0.04	U	0.041	U
Heptachlor Epoxide	ug/L	0.041	U	0.04	U	0.041	U
Heptachlor	ug/L	0.041	U	0.04	U	0.041	U
Methoxychlor	ug/L	0.39	U	0.38	U	0.39	U
p,p'-DDD	ug/L	0.082	U	0.08	U	0.082	U
p,p'-DDE	ug/L	0.082	U	0.08	U	0.082	U
p,p'-DDT	ug/L	0.082	U	0.085	U	0.082	U
Toxaphene	ug/L	2.6	U	2.5	U	2.6	U

	StationID	G006GW004		G006GW004		G006GW005	
	SampleID	006GW004M6		006HW004M6		006GW005M6	
	DateCollected	12/19/2002		12/19/2002		12/19/2002	
	DateExtracted	12/20/2002		12/20/2002		12/20/2002	
	DateAnalyzed	12/23/2002		12/23/2002		12/23/2002	
	SDGNumber	72452		72452		72452	
Parameter	Units						
Aldrin	ug/L	0.042	U	0.042	U	0.043	U
Alpha BHC (Alpha Hexachlorocyclohexane)	ug/L	0.042	U	0.042	U	0.043	U
Alpha-chlordane	ug/L	0.042	U	0.042	U	0.043	UJ
Beta BHC (Beta Hexachlorocyclohexane)	ug/L	0.042	U	0.042	U	0.043	U
Chlordane	ug/L	0.42	U	0.42	U	0.43	U
Delta BHC (Delta Hexachlorocyclohexane)	ug/L	0.042	U	0.042	U	0.043	U
Dieldrin	ug/L	0.083	U	0.084	U	0.087	U
Endosulfan I	ug/L	0.042	U	0.042	U	0.043	U
Endosulfan II	ug/L	0.083	U	0.084	U	0.087	U
Endosulfan Sulfate	ug/L	0.083	U	0.084	U	0.087	U
Endrin Aldehyde	ug/L	0.083	U	0.084	U	0.087	U
Endrin Ketone	ug/L	0.083	U	0.084	U	0.087	U
Endrin	ug/L	0.083	U	0.084	U	0.087	U
Gamma BHC (Lindane)	ug/L	0.042	U	0.042	U	0.043	U
Gamma-chlordane	ug/L	0.042	U	0.042	U	0.043	U
Heptachlor Epoxide	ug/L	0.042	U	0.042	U	0.043	U
Heptachlor	ug/L	0.042	U	0.042	U	0.043	U
Methoxychlor	ug/L	0.4	U	0.4	U	0.41	U
p,p'-DDD	ug/L	0.083	U	0.084	U	0.083	J
p,p'-DDE	ug/L	0.083	U	0.084	U	0.087	U
p,p'-DDT	ug/L	0.083	U	0.084	U	0.087	U
Toxaphene	ug/L	2.6	U	2.6	U	2.7	U

	StationID	G006GW006		G006GW007	
	SampleID	006GW006M6		006GW007M6	
	DateCollected	12/19/2002		12/19/2002	
	DateExtracted	12/20/2002		12/20/2002	
	DateAnalyzed	12/23/2002		12/23/2002	
	SDGNumber	72452		72452	
Parameter	Units				
Aldrin	ug/L	0.04	U	0.042	U
Alpha BHC (Alpha Hexachlorocyclohexane)	ug/L	0.04	U	0.042	U
Alpha-chlordane	ug/L	0.04	UJ	0.042	UJ
Beta BHC (Beta Hexachlorocyclohexane)	ug/L	0.04	U	0.042	U
Chlordane	ug/L	0.4	U	0.42	U
Delta BHC (Delta Hexachlorocyclohexane)	ug/L	0.04	U	0.042	U
Dieldrin	ug/L	0.08	U	0.083	U
Endosulfan I	ug/L	0.04	U	0.042	U
Endosulfan II	ug/L	0.08	U	0.083	U
Endosulfan Sulfate	ug/L	0.08	U	0.083	U
Endrin Aldehyde	ug/L	0.08	U	0.083	U
Endrin Ketone	ug/L	0.08	U	0.083	U
Endrin	ug/L	0.08	U	0.083	U
Gamma BHC (Lindane)	ug/L	0.04	U	0.042	U
Gamma-chlordane	ug/L	0.04	U	0.042	U
Heptachlor Epoxide	ug/L	0.04	U	0.042	U
Heptachlor	ug/L	0.04	U	0.042	U
Methoxychlor	ug/L	0.38	U	0.4	U
p,p'-DDD	ug/L	0.08	U	0.083	U
p,p'-DDE	ug/L	0.08	U	0.083	U
p,p'-DDT	ug/L	0.08	U	0.083	U
Toxaphene	ug/L	2.5	U	2.6	U

	StationID	G006GW001		G006GW002		G006GW003		G006GW004	
	SampleID	006GW001M6		006GW002M6		006GW003M6		006GW004M6	
	DateCollected	12/19/2002		12/19/2002		12/19/2002		12/19/2002	
	DateExtracted	12/21/2002		12/21/2002		12/21/2002		12/21/2002	
	DateAnalyzed	12/26/2002		12/31/2002		12/31/2002		12/31/2002	
	SDGNumber	72452		72452		72452		72452	
Parameter	Units								
Aluminum	ug/L	35.5	U	1780	U	355	U	178	U
Antimony	ug/L	6.61	U	6.61	U	6.61	U	6.61	U
Arsenic	ug/L	2.89	U	3.68	U	82.7	=	4.02	U
Barium	ug/L	6.39	J	104	J	192	J	313	J
Beryllium	ug/L	0.37	U	18.5	U	3.7	U	1.85	U
Cadmium	ug/L	0.403	U	0.623	U	0.485	U	0.403	U
Calcium	ug/L	95600	=	223000	J	141000	=	266000	=
Chromium, Total	ug/L	1.44	U	71.9	U	14.4	U	7.19	U
Cobalt	ug/L	1.29	U	1.29	U	1.29	U	1.29	U
Copper	ug/L	5.65	J	1.57	U	1.57	U	1.57	U
Iron	ug/L	61.1	J	21200	=	24100	J	19100	=
Lead	ug/L	1.78	U	1.78	U	2.28	J	1.78	U
Magnesium	ug/L	20700	=	765000	=	75800	=	54200	=
Manganese	ug/L	226	=	680	J	592	=	582	=
Nickel	ug/L	1.02	U	51	U	1.02	U	1.02	U
Potassium	ug/L	12000	=	229000	J	31100	J	28400	=
Selenium	ug/L	3.66	U	3.66	U	3.66	U	3.66	U
Silver	ug/L	1.17	U	61.1	J	11.7	U	5.83	U
Sodium	ug/L	20100	=	7000000	=	867000	=	580000	=
Thallium	ug/L	6.57	J	6.56	U	6.56	U	8.84	J
Vanadium	ug/L	2.39	J	77.1	U	15.4	U	7.71	U
Zinc	ug/L	4.94	U	28.7	U	5.74	U	5.71	U

	StationID	G006GW004		G006GW005		G006GW006		G006GW007	
	SampleID	006HW004M6		006GW005M6		006GW006M6		006GW007M6	
	DateCollected	12/19/2002		12/19/2002		12/19/2002		12/19/2002	
	DateExtracted	12/21/2002		12/21/2002		12/21/2002		12/21/2002	
	DateAnalyzed	12/31/2002		12/31/2002		12/31/2002		12/31/2002	
	SDGNumber	72452		72452		72452		72452	
Parameter	**Units**								
Aluminum	ug/L	178	U	1780	U	1780	U	711	U
Antimony	ug/L	6.61	U	6.61	U	6.61	U	6.61	U
Arsenic	ug/L	2.89	U	2.89	U	8.81	U	5.29	U
Barium	ug/L	309	J	44.7	J	50.1	J	28.8	J
Beryllium	ug/L	1.85	U	18.5	U	18.5	U	7.4	U
Cadmium	ug/L	0.403	U	0.403	U	0.403	U	0.403	U
Calcium	ug/L	263000	=	171000	J	132000	J	140000	=
Chromium, Total	ug/L	7.19	U	71.9	U	71.9	U	28.7	U
Cobalt	ug/L	1.29	U	1.29	U	1.29	U	1.29	U
Copper	ug/L	1.57	U	1.57	U	1.61	J	3.7	J
Iron	ug/L	19000	=	15400	J	10900	=	4230	=
Lead	ug/L	1.78	U	2.84	J	2.35	J	1.78	U
Magnesium	ug/L	54000	=	557000	J	435000	=	298000	=
Manganese	ug/L	582	=	481	=	209	=	854	=
Nickel	ug/L	1.02	U	5.99	U	1.02	U	1.02	U
Potassium	ug/L	28500	=	191000	J	161000	J	94800	J
Selenium	ug/L	3.66	U	3.66	U	3.66	U	3.66	U
Silver	ug/L	5.83	U	58.3	U	62.2	J	23.3	U
Sodium	ug/L	579000	=	5070000	J	4300000	=	2630000	=
Thallium	ug/L	6.56	U	6.56	U	6.56	U	6.56	U
Vanadium	ug/L	7.71	U	77.1	U	77.1	U	30.8	U
Zinc	ug/L	4.09	U	28.7	U	28.7	U	11.5	U

	StationID	G006GW001		G006GW002		G006G
	SampleID	006GW001M6		006GW002M6		006GW
	DateCollected	12/19/2002		12/19/2002		12/19
	DateExtracted	12/20/2002		12/20/2002		12/20
	DateAnalyzed	12/23/2002		12/23/2002		12/23
	SDGNumber	72456		72456		724
Parameter	Units					
Aldrin, Dissolved	ug/L	0.042	U	0.042	U	0.042
Alpha BHC (Alpha Hexachlorocyclohexane), Dissolved	ug/L	0.042	U	0.042	U	0.042
Alpha-chlordane, Dissolved	ug/L	0.042	UJ	0.042	UJ	0.042
Beta BHC (Beta Hexachlorocyclohexane), Dissolved	ug/L	0.042	U	0.042	U	0.042
Chlordane, Dissolved	ug/L	0.42	U	0.42	U	0.42
Delta BHC (Delta Hexachlorocyclohexane), Dissolved	ug/L	0.042	U	0.042	U	0.042
Dieldrin, Dissolved	ug/L	0.084	U	0.084	U	0.085
Endosulfan I, Dissolved	ug/L	0.042	U	0.042	U	0.042
Endosulfan II, Dissolved	ug/L	0.084	U	0.084	U	0.085
Endosulfan Sulfate, Dissolved	ug/L	0.084	U	0.084	U	0.085
Endrin Aldehyde, Dissolved	ug/L	0.084	U	0.084	U	0.085
Endrin Ketone, Dissolved	ug/L	0.084	U	0.084	U	0.085
Endrin, Dissolved	ug/L	0.084	U	0.084	U	0.085
Gamma BHC (Lindane), Dissolved	ug/L	0.042	U	0.042	U	0.042
Gamma-chlordane, Dissolved	ug/L	0.042	U	0.042	U	0.042
Heptachlor Epoxide, Dissolved	ug/L	0.042	U	0.042	U	0.042
Heptachlor, Dissolved	ug/L	0.042	U	0.042	U	0.042
Methoxychlor, Dissolved	ug/L	0.4	U	0.4	U	0.4
p,p'-DDD, Dissolved	ug/L	0.084	U	0.084	U	0.085
p,p'-DDE, Dissolved	ug/L	0.084	U	0.084	U	0.085
p,p'-DDT, Dissolved	ug/L	0.084	U	0.084	U	0.085
Toxaphene, Dissolved	ug/L	2.6	U	2.6	U	2.6

	StationID	W003	G006GW004		G006GW004	
	SampleID	003M6	006GW004M6		006HW004M6	
	DateCollected	/2002	12/19/2002		12/19/2002	
	DateExtracted	/2002	12/20/2002		12/20/2002	
	DateAnalyzed	/2002	12/23/2002		12/23/2002	
	SDGNumber	456	72456		72456	
Parameter	Units					
Aldrin, Dissolved	ug/L	U	0.042	U	0.042	U
Alpha BHC (Alpha Hexachlorocyclohexane), Dissolved	ug/L	U	0.042	U	0.042	U
Alpha-chlordane, Dissolved	ug/L	UJ	0.042	UJ	0.042	UJ
Beta BHC (Beta Hexachlorocyclohexane), Dissolved	ug/L	U	0.042	U	0.042	U
Chlordane, Dissolved	ug/L	U	0.42	U	0.42	U
Delta BHC (Delta Hexachlorocyclohexane), Dissolved	ug/L	U	0.042	U	0.042	U
Dieldrin, Dissolved	ug/L	U	0.085	U	0.083	U
Endosulfan I, Dissolved	ug/L	U	0.042	U	0.042	U
Endosulfan II, Dissolved	ug/L	U	0.085	U	0.083	U
Endosulfan Sulfate, Dissolved	ug/L	U	0.085	U	0.083	U
Endrin Aldehyde, Dissolved	ug/L	U	0.085	U	0.083	U
Endrin Ketone, Dissolved	ug/L	U	0.085	U	0.083	U
Endrin, Dissolved	ug/L	U	0.085	U	0.083	U
Gamma BHC (Lindane), Dissolved	ug/L	U	0.042	U	0.042	U
Gamma-chlordane, Dissolved	ug/L	U	0.042	U	0.042	U
Heptachlor Epoxide, Dissolved	ug/L	U	0.042	U	0.042	U
Heptachlor, Dissolved	ug/L	U	0.042	U	0.042	U
Methoxychlor, Dissolved	ug/L	U	0.4	U	0.4	U
p,p'-DDD, Dissolved	ug/L	U	0.085	U	0.083	U
p,p'-DDE, Dissolved	ug/L	U	0.085	U	0.083	U
p,p'-DDT, Dissolved	ug/L	U	0.085	U	0.083	U
Toxaphene, Dissolved	ug/L	U	2.6	U	2.6	U

	StationID	G006GW005		G006GW006		G006G
	SampleID	006GW005M6		006GW006M6		006GW
	DateCollected	12/19/2002		12/19/2002		12/19/
	DateExtracted	12/20/2002		12/20/2002		12/20/
	DateAnalyzed	12/23/2002		12/23/2002		12/23/
	SDGNumber	72456		72456		724
Parameter	Units					
Aldrin, Dissolved	ug/L	0.042	U	0.042	U	0.042
Alpha BHC (Alpha Hexachlorocyclohexane), Dissolved	ug/L	0.042	U	0.042	U	0.042
Alpha-chlordane, Dissolved	ug/L	0.042	UJ	0.042	UJ	0.042
Beta BHC (Beta Hexachlorocyclohexane), Dissolved	ug/L	0.042	U	0.042	U	0.042
Chlordane, Dissolved	ug/L	0.42	U	0.42	U	0.42
Delta BHC (Delta Hexachlorocyclohexane), Dissolved	ug/L	0.042	U	0.042	U	0.042
Dieldrin, Dissolved	ug/L	0.084	U	0.084	U	0.084
Endosulfan I, Dissolved	ug/L	0.042	U	0.042	U	0.042
Endosulfan II, Dissolved	ug/L	0.084	U	0.084	U	0.084
Endosulfan Sulfate, Dissolved	ug/L	0.084	U	0.084	U	0.084
Endrin Aldehyde, Dissolved	ug/L	0.084	U	0.084	U	0.084
Endrin Ketone, Dissolved	ug/L	0.084	U	0.084	U	0.084
Endrin, Dissolved	ug/L	0.084	U	0.084	U	0.084
Gamma BHC (Lindane), Dissolved	ug/L	0.042	U	0.042	U	0.042
Gamma-chlordane, Dissolved	ug/L	0.042	U	0.042	U	0.042
Heptachlor Epoxide, Dissolved	ug/L	0.042	U	0.042	U	0.042
Heptachlor, Dissolved	ug/L	0.042	U	0.042	U	0.042
Methoxychlor, Dissolved	ug/L	0.4	U	0.4	U	0.4
p,p'-DDD, Dissolved	ug/L	0.084	U	0.084	U	0.084
p,p'-DDE, Dissolved	ug/L	0.084	U	0.084	U	0.084
p,p'-DDT, Dissolved	ug/L	0.084	U	0.084	U	0.084
Toxaphene, Dissolved	ug/L	2.6	U	2.6	U	2.6

	StationID	W007
	SampleID	007M6
	DateCollected	2002
	DateExtracted	2002
	DateAnalyzed	2002
	SDGNumber	56
Parameter	**Units**	
Aldrin, Dissolved	ug/L	U
Alpha BHC (Alpha Hexachlorocyclohexane), Dissolved	ug/L	U
Alpha-chlordane, Dissolved	ug/L	UJ
Beta BHC (Beta Hexachlorocyclohexane), Dissolved	ug/L	U
Chlordane, Dissolved	ug/L	U
Delta BHC (Delta Hexachlorocyclohexane), Dissolved	ug/L	U
Dieldrin, Dissolved	ug/L	U
Endosulfan I, Dissolved	ug/L	U
Endosulfan II, Dissolved	ug/L	U
Endosulfan Sulfate, Dissolved	ug/L	U
Endrin Aldehyde, Dissolved	ug/L	U
Endrin Ketone, Dissolved	ug/L	U
Endrin, Dissolved	ug/L	U
Gamma BHC (Lindane), Dissolved	ug/L	U
Gamma-chlordane, Dissolved	ug/L	U
Heptachlor Epoxide, Dissolved	ug/L	U
Heptachlor, Dissolved	ug/L	U
Methoxychlor, Dissolved	ug/L	U
p,p'-DDD, Dissolved	ug/L	U
p,p'-DDE, Dissolved	ug/L	U
p,p'-DDT, Dissolved	ug/L	U
Toxaphene, Dissolved	ug/L	U

	StationID	G006GW001		G006GW002		G006GW003		G006GW004	
	SampleID	006GW001M6		006GW002M6		006GW003M6		006GW004M6	
	DateCollected	12/19/2002		12/19/2002		12/19/2002		12/19/2002	
	DateExtracted	12/21/2002		12/21/2002		12/21/2002		12/21/2002	
	DateAnalyzed	12/27/2002		12/31/2002		12/31/2002		12/31/2002	
	SDGNumber	72456		72456		72456		72456	
Parameter	**Units**								
Aluminum, Dissolved	ug/L	35.5	U	1780	U	916	J	178	U
Antimony, Dissolved	ug/L	6.61	U	6.61	U	6.61	U	6.61	U
Arsenic, Dissolved	ug/L	4.19	U	2.89	U	87.8	=	3.48	U
Barium, Dissolved	ug/L	6.37	J	84.7	J	193	J	316	J
Beryllium, Dissolved	ug/L	0.37	U	18.5	U	3.7	U	1.85	U
Cadmium, Dissolved	ug/L	0.486	U	0.48	U	0.481	U	0.403	U
Calcium, Dissolved	ug/L	97000	=	217000	J	141000	=	268000	=
Chromium, Dissolved	ug/L	1.44	U	71.9	U	14.4	U	7.19	U
Cobalt, Dissolved	ug/L	1.29	U	1.29	U	1.29	U	1.29	U
Copper, Dissolved	ug/L	5.8	J	1.76	J	1.57	U	1.57	U
Iron, Dissolved	ug/L	25.7	U	20200	=	25600	J	19200	=
Lead, Dissolved	ug/L	1.78	U	1.86	J	2.06	J	1.78	U
Magnesium, Dissolved	ug/L	21100	=	740000	=	75100	=	53500	=
Manganese, Dissolved	ug/L	228	=	648	J	603	=	597	=
Nickel, Dissolved	ug/L	1.72	U	51	U	1.02	U	1.02	U
Potassium, Dissolved	ug/L	12500	=	225000	J	31200	J	28400	=
Selenium, Dissolved	ug/L	3.66	U	3.66	U	3.66	U	3.66	U
Silver, Dissolved	ug/L	1.17	U	58.3	U	11.7	U	5.83	U
Sodium, Dissolved	ug/L	21000	=	6790000	=	864000	=	576000	=
Thallium, Dissolved	ug/L	6.56	U	6.56	U	6.56	U	6.56	U
Vanadium, Dissolved	ug/L	1.74	J	77.1	U	15.4	U	7.71	U
Zinc, Dissolved	ug/L	6.57	U	28.7	U	6.06	U	4.39	U

	StationID	G006GW004		G006GW005		G006GW006		G006GW007	
	SampleID	006HW004M6		006GW005M6		006GW006M6		006GW007M6	
	DateCollected	12/19/2002		12/19/2002		12/19/2002		12/19/2002	
	DateExtracted	12/21/2002		12/21/2002		12/21/2002		12/21/2002	
	DateAnalyzed	12/31/2002		12/31/2002		12/31/2002		12/31/2002	
	SDGNumber	72456		72456		72456		72456	
Parameter	**Units**								
Aluminum, Dissolved	ug/L	178	U	1780	U	1780	U	1780	U
Antimony, Dissolved	ug/L	6.61	U	6.61	U	6.61	U	6.61	U
Arsenic, Dissolved	ug/L	2.89	U	4.91	U	8.92	U	7.42	U
Barium, Dissolved	ug/L	308	J	49.6	J	39.7	J	39.1	J
Beryllium, Dissolved	ug/L	1.85	U	18.5	U	18.5	U	18.5	U
Cadmium, Dissolved	ug/L	0.403	U	0.403	U	0.403	U	0.403	U
Calcium, Dissolved	ug/L	262000	=	178000	J	128000	J	141000	J
Chromium, Dissolved	ug/L	7.19	U	71.9	U	71.9	U	71.9	U
Cobalt, Dissolved	ug/L	1.29	U	1.29	U	1.29	U	1.29	U
Copper, Dissolved	ug/L	1.57	U	2.56	J	1.81	J	2.76	J
Iron, Dissolved	ug/L	19200	=	16900	J	10700	=	3780	=
Lead, Dissolved	ug/L	1.78	U	1.78	U	1.78	U	1.78	U
Magnesium, Dissolved	ug/L	52400	=	597000	J	430000	=	313000	=
Manganese, Dissolved	ug/L	595	=	478	=	205	=	864	=
Nickel, Dissolved	ug/L	1.02	U	7.67	J	1.02	U	1.02	U
Potassium, Dissolved	ug/L	27600	=	201000	J	159000	J	98000	J
Selenium, Dissolved	ug/L	3.66	U	3.66	U	3.66	U	3.66	U
Silver, Dissolved	ug/L	5.83	U	58.3	U	58.3	U	58.3	U
Sodium, Dissolved	ug/L	561000	=	5470000	J	4210000	=	2650000	=
Thallium, Dissolved	ug/L	6.92	J	6.56	U	6.56	U	7.53	J
Vanadium, Dissolved	ug/L	7.71	U	77.1	U	77.1	U	77.1	U
Zinc, Dissolved	ug/L	2.87	U	28.7	U	28.7	U	28.7	U

MEMORANDUM **CH2MHILL**

Data Validation Summary - Charleston Naval Complex – Zone G, SWMU 6

TO: William Elliott/CH2M HILL/GNA

FROM: Amy Juchem/CH2M HILL/GNA
Herb Kelly/CH2M HILL/GNA

DATE: March 28, 2003

The purpose of this memorandum is to present the results of the data validation process for the groundwater samples collected at Zone G, SWMU 6. The samples were collected on December 19, 2002.

The specific samples and analytical fractions reviewed are summarized below in Table 1.

The Quality Control areas that were reviewed and the resulting findings are documented within each subsection that follows. This data was validated for compliance with the analytical method requirements. This process also included a review of the data to assess the accuracy, precision, and completeness based upon procedures described in the guidance documents such as the Environmental Protection Agency (EPA) *National Functional Guidelines for Inorganic Data Review (EPA 2002) and National Functional Guidelines for Organic Data Review (EPA 1999).* Quality assurance/quality control (QA/QC) summary forms and data reports were reviewed.

Samples were submitted to General Engineering Laboratories, Inc., in Charleston, South Carolina, for the following analyses: SW-846 8081 Pesticides (total and dissolved) and Metals (total and dissolved) following SW-846 6010/7000 Series methodology. As discussed earlier in the report, both Total and Dissolved pesticides were analyzed to determine potential origin of any detected parameter.

Sample results that were not within the acceptance limits were appended with a qualifying flag, which consisted of a single- or double-letter code that indicated a possible problem with the data. The qualifying flags originated during the data review and validation processes. These also include the secondary, or the two-digit "sub-qualifier" flags. The secondary qualifiers provide the reasoning behind the assignment of a qualifier flag to the data. The secondary qualifiers are presented and defined below.

Attachment 1 lists the changes in data qualifiers, due to the validation process.

The following primary flags were used to qualify the data:

[=] Detected. The analyte was analyzed for and detected at the concentration shown.

[J] Estimated. The analyte was present but the reported value may not be accurate or precise.

[U] Undetected. The analyte was analyzed for but not detected above the method detection limit.

[UJ] Detection limit estimated. The analyte was analyzed for but qualified as not detected; the result is estimated.

[R] Rejected. The data is not useable.

Secondary Data Validation Qualifiers

Code	Definition
2S	Second Source
2C	Second Column Confirmation
BL	Blank
BD	Blank Spike/Blank Spike Duplicate or (LCS/LCSD) Precision
BS	Blank Spike/LCS
CC	Continuing Calibration Verification
DL	Dilution
FD	Field Duplicate
HT	Holding Time
IB	In-Between (metals - B's → J's)
IC	Initial Calibration
IS	Internal Standard
LD	Lab Duplicate
LR	Concentration exceeded Linear Range
MD	MS/MSD or LCS/LCSD Precision
MS	Matrix Spike/Matrix Spike Duplicate
OT	Other (see DV worksheet)
PD	Pesticide Degradation
PS	Post Spike
RE	Re-extraction/Re-analysis
SD	Serial Dilution
SS	Spiked Surrogate
TD	Total vs Dissolved
TN	Tune

Table 1 - Chemical Analytical Methods – Field and Quality Control Samples

SDG	Station ID	Sample ID	Lab Sample ID	Matrix	Sample Type	Date Collected	Total Pesticides SW8081A	Dissolved Pesticides SW8081A	Total Metals SW6010B	Dissolved Metals SW6010B
72452	FIELDQC	006EW001M6	72452001	WQ	EB	12/19/02	X		X	
72452	G006GW001	006GW001M6	72452002	WG	N	12/19/02	X		X	
72452	G006GW002	006GW002M6	72452003	WG	N	12/19/02	X		X	
72452	G006GW003	006GW003M6	72452004	WG	N	12/19/02	X		X	
72452	G006GW004	006GW004M6	72452005	WG	N	12/19/02	X		X	
72452	G006GW004	006HW004M6	72452006	WG	FD	12/19/02	X		X	
72452	G006GW005	006GW005M6	72452007	WG	N	12/19/02	X		X	
72452	G006GW006	006GW006M6	72452008	WG	N	12/19/02	X		X	
72452	G006GW007	006GW007M6	72452009	WG	N	12/19/02	X		X	
72452	LABQC	1200355328	1200355328	WQ	LB		X			
72452	LABQC	1200355329	1200355329	WQ	BS		X			
72452	G006GW005	006GW005M6MS	1200355330	WG	MS	12/19/02	X			
72452	G006GW005	006GW005M6SD	1200355331	WG	SD	12/19/02	X			
72452	LABQC	1200355368	1200355368	WQ	LB				X	
72452	LABQC	1200355369	1200355369	WQ	BS				X	
72452	G006GW001	006GW001M6MS	1200355370	WG	MS	12/19/02			X	
72452	G006GW001	006GW001M6SD	1200355371	WG	SD	12/19/02			X	
72456	FIELDQC	006EW001M6	72456001	WQ	EB	12/19/02		X		X
72456	G006GW001	006GW001M6	72456002	WG	N	12/19/02		X		X
72456	G006GW002	006GW002M6	72456003	WG	N	12/19/02		X		X

SDG	Station ID	Sample ID	Lab Sample ID	Matrix	Sample Type	Date Collected	Total Pesticides SW8081A	Dissolved Pesticides SW8081A	Total Metals SW6010B	Dissolved Metals SW6010B
72456	G006GW003	006GW003M6	72456004	WG	N	12/19/02		X		X
72456	G006GW004	006GW004M6	72456005	WG	N	12/19/02		X		X
72456	G006GW004	006HW004M6	72456006	WG	FD	12/19/02		X		X
72456	G006GW005	006GW005M6	72456007	WG	N	12/19/02		X		X
72456	G006GW006	006GW006M6	72456008	WG	N	12/19/02		X		X
72456	G006GW007	006GW007M6	72456009	WG	N	12/19/02		X		X
72456	LABQC	1200355328	1200355328	WQ	LB		X			
72456	LABQC	1200355329	1200355329	WQ	BS		X			
72456	LABQC	1200355368	1200355368	WQ	LB				X	
72456	LABQC	1200355369	1200355369	WQ	BS				X	

MATRIX CODE

WG – Ground Water Samples
WQ – Water QC Samples

SAMPLE TYPE CODE

EB - Equipment Blank
FD - Field Duplicate
MS - Matrix Spike
SD - Matrix Spike Duplicate
LB – Laboratory Blank
BS – Laboratory Blank Spike
N - Native Sample

Organic Parameters

Quality Control Review

The following list represents the QA/QC measures that were reviewed during the data quality evaluation procedure for organic data.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Method blanks and equipment blanks, were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Surrogate Recoveries** – Surrogate Compounds are added to each sample and the recoveries are used to monitor lab performance and possible matrix interference.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", either laboratory reagent water or Ottawa sand, in which target compounds have been added prior to extraction/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and its duplicate. This information can only be determined when target compounds are detected.
- **Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples** – Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. Precision information is also determined by calculating the reproducibility between the recoveries of each spiked parameter.
- **GC/MS Tuning** – The mass spectrum of the tuning compound is evaluated for method compliance. The criteria are established to verify the proper mass assignment and mass resolution.
- **Initial Calibration** – The initial calibration ensures that the instrument is capable of producing acceptable qualitative and quantitative data for the compounds of interest.
- **Continuing Calibration** – The continuing calibration checks satisfactory performance of the instrument and its predicted response to the target compounds.
- **Internal Standards** – The internal standards (retention time and response) are evaluated for method compliance. The internal standards are used in quantitation of the target parameters and monitor the instrument sensitivity and response for stability during each analysis.
- **Confirmation** – If GCMS methodology is not initially used for analysis, SW-846 method 8000 requires confirmation when the composition of samples is not well characterized.

Therefore, even when the identification has been confirmed on a dissimilar column or detector, the agreement of the quantitative results on both columns is evaluated. For Pesticide and PCB analyses covered in this report, confirmation was performed using a dissimilar analytical column. The laboratory analyzed samples with a gas chromatograph (GC) utilizing simultaneous primary and confirmation data acquisition. Per SW-86 method 8000, 40% RPD criteria was used as the acceptance limit.

Organochlorine Pesticides

The QA/QC parameters for the Organochlorine Pesticides analyses by method SW-846 8081 for all of the samples were within acceptable control limits, except as noted below.

Blanks

The Pesticides target parameters detected in blank samples are listed in Table 2.

TABLE 2
Equipment Blank Contamination: Pesticides
Charleston Naval Complex, Zone G, SWMU 6, Charleston, SC

SDG	Sample ID	Lab Sample ID	Sample Type	Parameter	Lab Result	Units	Flag Concentrations
72452	1200355328	1200355328	LB	4,4'-DDT	0.035	µg/L	0.175 µg/L
72452	006EW001M6	72452001	EB	4,4'-DDT	0.069	µg/L	0.345 µg/L
72452	006EW001M6	72452001	EB	4,4'-DDE	0.032	µg/L	0.160 µg/L
72456	1200355328	1200355328	LB	4,4'-DDT	0.035	µg/L	0.175 µg/L

If a target parameter determined to be a common contaminant was reported in a field sample, and the concentration was below the level determined to be due to blank contamination, the following actions were taken:

- If the concentration was above the reporting limit, the numeric result was unchanged, but it was flagged "U", as undetected.
- If the concentration was below the reporting limit, the numeric result was changed to the value of the reporting limit, and it was flagged "U", as undetected.

The results qualified due to blank contamination are listed in Attachment 1.

Initial and Continuing Calibration Criteria

All initial and continuing calibration criteria were met except as noted in Table 3.

TABLE 3
Exceptions to Initial Calibration Criteria and Continuing Calibration Criteria: Pesticides
Charleston Naval Complex, Zone G, SWMU 6, Charleston, SC

Instrument/Calibration Date	Analyte	%Relative Standard Deviation (ICAL)/ %Difference (CCAL)	Associated Samples
ECD3A#1-CCAL-12/23/02, 1018	Chlordane (tech)	29.0% high	72452 – All 72456 – All
ECD3A#1-CCAL-12/23/02, 1509	Alpha-Chlordane	16.9% low	72452007, 72452008, 72452009, 72456 – All
ECD3A#1-CCAL-12/23/02, 1541	Alpha-Chlordane	15.3% low	72456008, 72456009
ECD3A#2-CCAL-12/23/02, 1541	Methoxychlor	16.0% high	72456008, 72456009
	Endrin ketone	21.5% high	

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent difference (%D) was low in the continuing calibration standards, detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated.
- When the percent difference (%D) was high in the continuing calibration standard, detected compounds were flagged "J", as estimated. Non-detected compounds were not flagged.

Inorganic Parameters

Quality Control Review

The following list represents the QA/QC measures that are typically reviewed during the data quality evaluation procedure for inorganic parameters.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Sample preparation, initial calibration blanks/continuing calibration blanks, and equipment blanks were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", in which target parameters have been added prior to digestion/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and its duplicate. This information can only be determined when target compounds are detected.
- **Pre/Post Digestion Spike (MS/MSD)** – Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. Precision information is also determined by calculating the reproducibility between the recoveries of each spiked parameter.
- **ICP Interference Check Sample** – This sample verifies the lab's interelement and background correction factors.
- **Initial Calibration Verification** – This parameter ensures that the instrument is capable of producing acceptable quantitative data for the target analyte list to be measured.
- **Continuing Calibration Verification** – This one-point, mid-range parameter establishes that the initial calibration is still valid by checking the performance of the instrument on a continual basis.
- **ICP Serial Dilution** – The serial dilution of samples quantitated by ICP determines whether or not significant physical or chemical interferences exist due to the sample matrix.

Metals Analyses

The QA/QC parameters for the Metals analyses for all of the samples were within acceptable control limits, except as noted below.

Blanks

The Metals target parameters detected in blank samples are listed in Table 4.

TABLE 4
Blank Contamination: Metals
Charleston Naval Complex, Zone G, SWMU 6, Charleston, SC

SDG	Lab Sample ID	Sample ID	Sample Type	Parameter	Lab Result	Units	Flag - Concentrations less than the value listed below
72452	CCB		CCB	Arsenic	3.89	ug/L	19.45 ug/L
72452	CCB		CCB	Cadmium	0.461	ug/L	2.305 ug/L
72452	CCB		CCB	Calcium	46.0	ug/L	230 ug/L
72452	CCB		CCB	Iron	11.4	ug/L	57 ug/L
72452	CCB		CCB	Magnesium	31.3	ug/L	156.5 ug/L
72452	CCB		CCB	Nickel	1.40	ug/L	7.0 ug/L
72452	CCB		CCB	Potassium	41.6	ug/L	208 ug/L
72452	CCB		CCB	Silver	1.56	ug/L	7.8 ug/L
72452	CCB		CCB	Sodium	221	ug/L	1105 ug/L
72452	CCB		CCB	Zinc	2.43	ug/L	12.15 ug/L
72452	1200355368	1200355368	LB	Zinc	0.633	ug/L	3.165 ug/L
72452	72452001	006EW001M6	EB	Arsenic	3.18	ug/L	15.9 ug/L
72456	CCB		CCB	Arsenic	3.89	ug/L	19.45 ug/L
72456	CCB		CCB	Cadmium	0.461	ug/L	2.305 ug/L
72456	CCB		CCB	Calcium	46.0	ug/L	230 ug/L
72456	CCB		CCB	Iron	11.4	ug/L	57 ug/L
72456	CCB		CCB	Magnesium	31.3	ug/L	156.5 ug/L
72456	CCB		CCB	Nickel	1.40	ug/L	7.0 ug/L
72456	CCB		CCB	Potassium	41.6	ug/L	208 ug/L
72456	CCB		CCB	Silver	1.56	ug/L	7.8 ug/L
72456	CCB		CCB	Sodium	221	ug/L	1105 ug/L
72456	CCB		CCB	Zinc	2.43	ug/L	12.15 ug/L

TABLE 4
Blank Contamination: Metals
Charleston Naval Complex, Zone G, SWMU 6, Charleston, SC

SDG	Lab Sample ID	Sample ID	Sample Type	Parameter	Lab Result	Units	Flag Concentrations less than the value listed below
72456	1200355368	1200355368	LB	Zinc	0.633	ug/L	3.165 ug/L
72456	72456001	006EW001M6	EB	Calcium, dissolved	46.7	ug/L	233.5 ug/L
72456	72456001	006EW001M6	EB	Magnesium, dissolved	85.6	ug/L	428 ug/L
72456	72456001	006EW001M6	EB	Potassium, dissolved	59.5	ug/L	297.5 ug/L
72456	72456001	006EW001M6	EB	Sodium, dissolved	953	ug/L	4765 ug/L
72456	72456001	006EW001M6	EB	Zinc, dissolved	1.03	ug/L	5.15 ug/L

If a target parameter was reported in a field sample, and the concentration was below the level determined to be due to blank contamination (5 times the concentration in the associated QC blank samples), it was flagged as "U", not detected. Initial and continuing calibration blanks were also evaluated for possible contamination.

The results qualified due to blank contamination are listed in Attachment 1.

Total versus Dissolved

All Total versus Dissolved sample comparisons were within acceptable quality control limits, except as noted in Table 5 below. Results are qualified "J" for detects and "UJ" for non-detects if the dissolved value is greater than the total value by more than five percent.

TABLE 5
Total vs Dissolved Out of QC Limits: Metals
Charleston Naval Complex, Zone G, SWMU 6, Charleston, SC

SDG	Sample	Parameter	Total Concentration	Dissolved Concentration	RPD	RPD Limits
72452 / 72456	72452004 / 72456004 (006GW003M6)	Iron, total / dissolved	24100 ug/L	25600	6*	5
72452 / 72456	72452007 / 72456007 (006GW005M6)	Iron, total / dissolved	15400 ug/L	16900 ug/L	9.3*	5
		Magnesium, total / dissolved	557000 ug/L	597000 ug/L	6.9*	5
		Sodium, total / dissolved	5070000 ug/L	5470000 ug/L	7.6*	5

* - out of control limits

Rejected Data

No data were rejected based upon the validation process for this sampling event.

Conclusion

A review of the analytical data submitted regarding the investigation of SWMU 6 in Zone G at the Charleston Naval Complex, Charleston, South Carolina by CH2M HILL has been completed. An overall evaluation of the data indicates that the sample handling, shipment, and analytical procedures have been adequately completed, and that the analytical results should be considered usable as qualified.

The analytical data had minor QC concerns as indicated above, however, it did not affect data usability for those specific results. The validation review demonstrated that the analytical systems were generally in control and the data results can be used in the decision making process.

Attachment 1 - Changed Qualifiers and Results
Zone G, SWMU (ata Validation

Parameter Class	Analytical Method	Parameter	SDG	Sample ID	Lab Sample ID	Matrix	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
FLTMET	SW6010B	ALUMINUM, Dissolved	72456	006GW003M6	72456004	WG	916	B	916	J	ug/L	IB
FLTMET	SW6010B	ARSENIC, Dissolved	72456	006GW001M6	72456002	WG	4.19	B	4.19	U	ug/L	BL
FLTMET	SW6010B	ARSENIC, Dissolved	72456	006GW004M6	72456005	WG	3.48	B	3.48	U	ug/L	BL
FLTMET	SW6010B	ARSENIC, Dissolved	72456	006GW005M6	72456007	WG	4.91	B	4.91	U	ug/L	BL
FLTMET	SW6010B	ARSENIC, Dissolved	72456	006GW006M6	72456008	WG	8.92	B	8.92	U	ug/L	BL
FLTMET	SW6010B	ARSENIC, Dissolved	72456	006GW007M6	72456009	WG	7.42	B	7.42	U	ug/L	BL
FLTMET	SW6010B	BARIUM, Dissolved	72456	006GW001M6	72456002	WG	6.37	B	6.37	J	ug/L	IB
FLTMET	SW6010B	BARIUM, Dissolved	72456	006GW002M6	72456003	WG	84.7	B	84.7	J	ug/L	IB
FLTMET	SW6010B	BARIUM, Dissolved	72456	006GW003M6	72456004	WG	193	B	193	J	ug/L	IB
FLTMET	SW6010B	BARIUM, Dissolved	72456	006GW004M6	72456005	WG	316	B	316	J	ug/L	IB
FLTMET	SW6010B	BARIUM, Dissolved	72456	006HW004M6	72456006	WG	308	B	308	J	ug/L	IB
FLTMET	SW6010B	BARIUM, Dissolved	72456	006GW005M6	72456007	WG	49.6	B	49.6	J	ug/L	IB
FLTMET	SW6010B	BARIUM, Dissolved	72456	006GW006M6	72456008	WG	39.7	B	39.7	J	ug/L	IB
FLTMET	SW6010B	BARIUM, Dissolved	72456	006GW007M6	72456009	WG	39.1	B	39.1	J	ug/L	IB
FLTMET	SW6010B	CADMIUM, Dissolved	72456	006GW001M6	72456002	WG	0.486	B	0.486	U	ug/L	BL
FLTMET	SW6010B	CADMIUM, Dissolved	72456	006GW002M6	72456003	WG	0.48	B	0.48	U	ug/L	BL
FLTMET	SW6010B	CADMIUM, Dissolved	72456	006GW003M6	72456004	WG	0.481	B	0.481	U	ug/L	BL
FLTMET	SW6010B	CALCIUM, Dissolved	72456	006GW002M6	72456003	WG	217000	B	217000	J	ug/L	IB
FLTMET	SW6010B	CALCIUM, Dissolved	72456	006GW005M6	72456007	WG	178000	B	178000	J	ug/L	IB
FLTMET	SW6010B	CALCIUM, Dissolved	72456	006GW006M6	72456008	WG	128000	B	128000	J	ug/L	IB
FLTMET	SW6010B	CALCIUM, Dissolved	72456	006GW007M6	72456009	WG	141000	B	141000	J	ug/L	IB
FLTMET	SW6010B	COPPER, Dissolved	72456	006GW001M6	72456002	WG	5.8	B	5.8	J	ug/L	IB
FLTMET	SW6010B	COPPER, Dissolved	72456	006GW002M6	72456003	WG	1.76	B	1.76	J	ug/L	IB
FLTMET	SW6010B	COPPER, Dissolved	72456	006GW005M6	72456007	WG	2.56	B	2.56	J	ug/L	IB
FLTMET	SW6010B	COPPER, Dissolved	72456	006GW006M6	72456008	WG	1.81	B	1.81	J	ug/L	IB
FLTMET	SW6010B	COPPER, Dissolved	72456	006GW007M6	72456009	WG	2.76	B	2.76	J	ug/L	IB
FLTMET	SW6010B	IRON, Dissolved	72456	006GW001M6	72456002	WG	25.7	B	25.7	U	ug/L	BL
FLTMET	SW6010B	IRON, Dissolved	72456	006GW003M6	72456004	WG	25600	=	25600	J	ug/L	TD
FLTMET	SW6010B	IRON, Dissolved	72456	006GW005M6	72456007	WG	16900	=	16900	J	ug/L	TD
FLTMET	SW6010B	LEAD, Dissolved	72456	006GW002M6	72456003	WG	1.86	B	1.86	J	ug/L	IB

Parameter Class	Analytical Method	Parameter	SDG	Sample ID	Lab Sample ID	Matrix	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
FLTMET	SW6010B	LEAD, Dissolved	72456	006GW003M6	72456004	WG	2.06	B	2.06	J	ug/L	IB
FLTMET	SW6010B	MAGNESIUM, Dissolved	72456	006GW005M6	72456007	WG	597000	=	597000	J	ug/L	TD
FLTMET	SW6010B	MANGANESE, Dissolved	72456	006GW002M6	72456003	WG	648	B	648	J	ug/L	IB
FLTMET	SW6010B	NICKEL, Dissolved	72456	006GW001M6	72456002	WG	1.72	B	1.72	U	ug/L	BL
FLTMET	SW6010B	NICKEL, Dissolved	72456	006GW005M6	72456007	WG	7.67	B	7.67	J	ug/L	IB
FLTMET	SW6010B	POTASSIUM, Dissolved	72456	006GW002M6	72456003	WG	225000	B	225000	J	ug/L	IB
FLTMET	SW6010B	POTASSIUM, Dissolved	72456	006GW003M6	72456004	WG	31200	B	31200	J	ug/L	IB
FLTMET	SW6010B	POTASSIUM, Dissolved	72456	006GW005M6	72456007	WG	201000	B	201000	J	ug/L	IB
FLTMET	SW6010B	POTASSIUM, Dissolved	72456	006GW006M6	72456008	WG	159000	B	159000	J	ug/L	IB
FLTMET	SW6010B	POTASSIUM, Dissolved	72456	006GW007M6	72456009	WG	98000	B	98000	J	ug/L	IB
FLTMET	SW6010B	SODIUM, Dissolved	72456	006GW005M6	72456007	WG	5E+06	=	5E+06	J	ug/L	TD
FLTMET	SW6010B	THALLIUM, Dissolved	72456	006HW004M6	72456006	WG	6.92	B	6.92	J	ug/L	IB
FLTMET	SW6010B	THALLIUM, Dissolved	72456	006GW007M6	72456009	WG	7.53	B	7.53	J	ug/L	IB
FLTMET	SW6010B	VANADIUM, Dissolved	72456	006GW001M6	72456002	WG	1.74	B	1.74	J	ug/L	IB
FLTMET	SW6010B	ZINC, Dissloved	72456	006GW001M6	72456002	WG	6.57	B	6.57	U	ug/L	BL
FLTMET	SW6010B	ZINC, Dissloved	72456	006GW003M6	72456004	WG	6.06	B	6.06	U	ug/L	BL
FLTMET	SW6010B	ZINC, Dissloved	72456	006GW004M6	72456005	WG	4.39	B	4.39	U	ug/L	BL
FLTPEST	SW8081A	Alpha-chlordane, Dissolved	72456	006GW001M6	72456002	WG	0.042	U	0.042	UJ	ug/L	CC
FLTPEST	SW8081A	Alpha-chlordane, Dissolved	72456	006GW002M6	72456003	WG	0.042	U	0.042	UJ	ug/L	CC
FLTPEST	SW8081A	Alpha-chlordane, Dissolved	72456	006GW003M6	72456004	WG	0.042	U	0.042	UJ	ug/L	CC
FLTPEST	SW8081A	Alpha-chlordane, Dissolved	72456	006GW004M6	72456005	WG	0.042	U	0.042	UJ	ug/L	CC
FLTPEST	SW8081A	Alpha-chlordane, Dissolved	72456	006HW004M6	72456006	WG	0.042	U	0.042	UJ	ug/L	CC
FLTPEST	SW8081A	Alpha-chlordane, Dissolved	72456	006GW005M6	72456007	WG	0.042	U	0.042	UJ	ug/L	CC
FLTPEST	SW8081A	Alpha-chlordane, Dissolved	72456	006GW006M6	72456008	WG	0.042	U	0.042	UJ	ug/L	CC
FLTPEST	SW8081A	Alpha-chlordane, Dissolved	72456	006GW007M6	72456009	WG	0.042	U	0.042	UJ	ug/L	CC
FLTPEST	SW8081A	p,p'-DDT, Dissolved	72456	006GW001M6	72456002	WG	0.039	JBP	0.084	U	ug/L	BL
FLTPEST	SW8081A	p,p'-DDT, Dissolved	72456	006GW003M6	72456004	WG	0.083	JB	0.085	U	ug/L	BL
FLTPEST	SW8081A	p,p'-DDT, Dissolved	72456	006GW004M6	72456005	WG	0.038	JBP	0.085	U	ug/L	BL
FLTPEST	SW8081A	p,p'-DDT, Dissolved	72456	006HW004M6	72456006	WG	0.033	JB	0.083	U	ug/L	BL
FLTPEST	SW8081A	p,p'-DDT, Dissolved	72456	006GW006M6	72456008	WG	0.063	JB	0.084	U	ug/L	BL

Attachment 1 - Changed Qualifiers and Results
Zone G, SWMU ata Validation

Parameter Class	Analytical Method	Parameter	SDG	Sample ID	Lab Sample ID	Matrix	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
FLTPEST	SW8081A	p,p'-DDT, Dissolved	72456	006GW007M6	72456009	WG	0.032	JB	0.084	U	ug/L	BL
METAL	SW6010B	ARSENIC	72452	006GW002M6	72452003	WG	3.68	B	3.68	U	ug/L	BL
METAL	SW6010B	ARSENIC	72452	006GW004M6	72452005	WG	4.02	B	4.02	U	ug/L	BL
METAL	SW6010B	ARSENIC	72452	006GW006M6	72452008	WG	8.81	B	8.81	U	ug/L	BL
METAL	SW6010B	ARSENIC	72452	006GW007M6	72452009	WG	5.29	B	5.29	U	ug/L	BL
METAL	SW6010B	BARIUM	72452	006GW001M6	72452002	WG	6.39	B	6.39	J	ug/L	IB
METAL	SW6010B	BARIUM	72452	006GW002M6	72452003	WG	104	B	104	J	ug/L	IB
METAL	SW6010B	BARIUM	72452	006GW003M6	72452004	WG	192	B	192	J	ug/L	IB
METAL	SW6010B	BARIUM	72452	006GW004M6	72452005	WG	313	B	313	J	ug/L	IB
METAL	SW6010B	BARIUM	72452	006HW004M6	72452006	WG	309	B	309	J	ug/L	IB
METAL	SW6010B	BARIUM	72452	006GW005M6	72452007	WG	44.7	B	44.7	J	ug/L	IB
METAL	SW6010B	BARIUM	72452	006GW006M6	72452008	WG	50.1	B	50.1	J	ug/L	IB
METAL	SW6010B	BARIUM	72452	006GW007M6	72452009	WG	28.8	B	28.8	J	ug/L	IB
METAL	SW6010B	CADMIUM	72452	006GW002M6	72452003	WG	0.623	B	0.623	U	ug/L	BL
METAL	SW6010B	CADMIUM	72452	006GW003M6	72452004	WG	0.485	B	0.485	U	ug/L	BL
METAL	SW6010B	CALCIUM	72452	006GW002M6	72452003	WG	223000	B	223000	J	ug/L	IB
METAL	SW6010B	CALCIUM	72452	006GW005M6	72452007	WG	171000	B	171000	J	ug/L	IB
METAL	SW6010B	CALCIUM	72452	006GW006M6	72452008	WG	132000	B	132000	J	ug/L	IB
METAL	SW6010B	COPPER	72452	006GW001M6	72452002	WG	5.65	B	5.65	J	ug/L	IB
METAL	SW6010B	COPPER	72452	006GW006M6	72452008	WG	1.61	B	1.61	J	ug/L	IB
METAL	SW6010B	COPPER	72452	006GW007M6	72452009	WG	3.7	B	3.7	J	ug/L	IB
METAL	SW6010B	IRON	72452	006GW001M6	72452002	WG	61.1	B	61.1	J	ug/L	IB
METAL	SW6010B	IRON	72452	006GW003M6	72452004	WG	24100	=	24100	J	ug/L	TD
METAL	SW6010B	IRON	72452	006GW005M6	72452007	WG	15400	=	15400	J	ug/L	TD
METAL	SW6010B	LEAD	72452	006GW003M6	72452004	WG	2.28	B	2.28	J	ug/L	IB
METAL	SW6010B	LEAD	72452	006GW005M6	72452007	WG	2.84	B	2.84	J	ug/L	IB
METAL	SW6010B	LEAD	72452	006GW006M6	72452008	WG	2.35	B	2.35	J	ug/L	IB
METAL	SW6010B	MAGNESIUM	72452	006GW005M6	72452007	WG	557000	=	557000	J	ug/L	TD
METAL	SW6010B	MANGANESE	72452	006GW002M6	72452003	WG	680	B	680	J	ug/L	IB
METAL	SW6010B	NICKEL	72452	006GW005M6	72452007	WG	5.99	B	5.99	U	ug/L	BL

Attachment 1 - Changed Qualifiers and Results
Zone G, SWMU Data Validation

Parameter Class	Analytical Method	Parameter	SDG	Sample ID	Lab Sample ID	Matrix	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
METAL	SW6010B	POTASSIUM	72452	006GW002M6	72452003	WG	229000	B	229000	J	ug/L	IB
METAL	SW6010B	POTASSIUM	72452	006GW003M6	72452004	WG	31100	B	31100	J	ug/L	IB
METAL	SW6010B	POTASSIUM	72452	006GW005M6	72452007	WG	191000	B	191000	J	ug/L	IB
METAL	SW6010B	POTASSIUM	72452	006GW006M6	72452008	WG	161000	B	161000	J	ug/L	IB
METAL	SW6010B	POTASSIUM	72452	006GW007M6	72452009	WG	94800	B	94800	J	ug/L	IB
METAL	SW6010B	SILVER	72452	006GW002M6	72452003	WG	61.1	B	61.1	J	ug/L	IB
METAL	SW6010B	SILVER	72452	006GW006M6	72452008	WG	62.2	B	62.2	J	ug/L	IB
METAL	SW6010B	SODIUM	72452	006GW005M6	72452007	WG	5E+06	=	5E+06	J	ug/L	TD
METAL	SW6010B	THALLIUM	72452	006GW001M6	72452002	WG	6.57	B	6.57	J	ug/L	IB
METAL	SW6010B	THALLIUM	72452	006GW004M6	72452005	WG	8.84	B	8.84	J	ug/L	IB
METAL	SW6010B	VANADIUM	72452	006GW001M6	72452002	WG	2.39	B	2.39	J	ug/L	IB
METAL	SW6010B	ZINC	72452	006GW001M6	72452002	WG	4.94	B	4.94	U	ug/L	BL
METAL	SW6010B	ZINC	72452	006GW004M6	72452005	WG	5.71	B	5.71	U	ug/L	BL
METAL	SW6010B	ZINC	72452	006HW004M6	72452006	WG	4.09	B	4.09	U	ug/L	BL
PEST	SW8081A	ALPHA-CHLORDANE	72452	006GW005M6	72452007	WG	0.043	U	0.043	UJ	ug/L	CC
PEST	SW8081A	ALPHA-CHLORDANE	72452	006GW006M6	72452008	WG	0.04	U	0.04	UJ	ug/L	CC
PEST	SW8081A	ALPHA-CHLORDANE	72452	006GW007M6	72452009	WG	0.042	U	0.042	UJ	ug/L	CC
PEST	SW8081A	p,p'-DDE	72452	006GW002M6	72452003	WG	0.017	J	0.08	U	ug/L	BL
PEST	SW8081A	p,p'-DDE	72452	006GW003M6	72452004	WG	0.077	J	0.082	U	ug/L	BL
PEST	SW8081A	p,p'-DDE	72452	006GW005M6	72452007	WG	0.082	JP	0.087	U	ug/L	BL
PEST	SW8081A	p,p'-DDT	72452	006GW002M6	72452003	WG	0.085	B	0.085	U	ug/L	BL
PEST	SW8081A	p,p'-DDT	72452	006GW003M6	72452004	WG	0.072	JB	0.082	U	ug/L	BL
PEST	SW8081A	p,p'-DDT	72452	006GW005M6	72452007	WG	0.061	JB	0.087	U	ug/L	BL
PEST	SW8081A	p,p'-DDT	72452	006GW007M6	72452009	WG	0.033	JB	0.083	U	ug/L	BL

Appendix B

COMPARISON OF TOTAL COST OF REMEDIAL SOLUTIONS

Site: Charleston Naval Complex
Location: SWMU 6
Phase: Corrective Measures Study
Base Year: 2003
Date: 10/07/03

	Alternative Number 1 **Long Term Monitoring With LUCs**	Alternative Number 2 **LUCs**
Total Assumed Project Duration (Years)	30	30
Capital Cost/O&M Cost	$31,200	$20,000
Annual Monitoring Cost (up to 5 years)	$5,000	$0
Total Present Worth of Solution	#REF!	$20,000

Disclaimer: The information in this cost estimate is based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude cost estimate that is expected to be within -30 to +50 percent of the actual project costs.

Element: Sample Collection and Laboratory Costs
Alternative: 1, 2

Site: Charleston Naval Complex
Location: SWMU 6
Phase: Corrective Measures study
Base Year: 2003

Prepared By: DFW **Date:** 10/07/03
Checked By: **Date:**

WORK STATEMENT

Costs associated with water sample collection, shipment and analysis on a per event basis; no natural attenuation parameters.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor per Event					STL estimate
Sample Analysis (Pesticides and 2 metals)	5	SAMPLE	$200	$1,000	6 Wells, 2 extra QA/QC samples
Sampling Supplies	1	EA	$200	$200	
Groundwater Sampling Equipment Rental	0.5	WK	$600	$300	Includes MultiRAE and Peristaltic Pump
Sample Shipment	1	EA	$100	$100	CH2M-Jones Estimate
Labor - Technicians	30	HR	$55	$1,650	3 hrs/well, 2 people, includes data validation
SUBTOTAL				**$3,250**	
Project Management	2%	of	$3,250	$65	
Technical Support	2%	of	$3,250	$65	
Construction Management	0%	of	$3,250	$0	
Subcontractor General Requirements	0%	of	$3,250	$0	
SUBTOTAL				**$3,380**	
TOTAL UNIT COST				**$3,400**	

OPERATION AND MAINTENANCE COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
SUBTOTAL				$0	
Contingency	20%		$0	$0	
SUBTOTAL				$0	
TOTAL O&M COST				**$0**	

Source of Cost Data

1. Analytical Bid Form - Charleston Naval Complex - Level III

Alternative 1: TLM and LUCs

COST ESTIMATE SUMMARY

Site: Charleston Naval Complex
Location: SWMU 6
Phase: Corrective Measures Study
Base Year: 2002
Date: 10/07/03

Description:
Monitoring of the surficial aquifer.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
Monitoring Plan				
Labor - Project Manager	4	HR	$125	$500
Labor - Engineer/Hydrogeologist	16	HR	$90	$1,440
Labor - Editor	4	HR	$65	$260
Labor - CAD Technician	4	HR	$65	$260
Initial Groundwater Sample Collection	1	EA	$3,380	$3,380
Initial Soil samples for PCBs	4	EA	$160	$640
SUBTOTAL				**$6,480**
Project Management	5%	of	$6,480	$324
Technical Support	5%	of	$6,480	$324
Cost for LUCs	1	EA	$20,000	$20,000
SUBTOTAL				**$27,128**
Contingency	15%	of	$27,128	$4,069
TOTAL CAPITAL COST				**$31,200**

OPERATIONS AND MAINTENANCE COST

	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
yrs 1 - 5	Annual Groundwater Sample Collection	1	EA	$3,380	**$3,380**
	Annual Report				
	Labor - Project Manager	2	HR	$125	$250
	Labor - Engineer/Hydrogeologist	8	HR	$90	$720
	Labor - Editor	4	HR	$65	$260
	Labor - CAD Technician	6	HR	$65	$390
	SUBTOTAL				**$1,620**
yrs 1 - 5	**TOTAL ANNUAL O&M COST**				**$5,000**

PRESENT VALUE ANALYSIS

Discount Rate = 3.2%

End Year	COST TYPE	TOTAL COST	COST PER YEAR	TOTAL PRESENT WORTH
1	FIRST YEAR CAPITAL COST	$31,200	$31,200	$31,200
1 - 5	ANNUAL O&M COST (Year 1 - 15)	#REF!	$5,000	#REF!
				#REF!
	TOTAL PRESENT WORTH OF ALTERNATIVE			**#REF!**

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

APPENDIX C

Responses to Comments

CH2MHILL TRANSMITTAL

To: David Scaturo
South Carolina Department of Health
and Environmental Control
Bureau of Land and Waste
Management
8901 Farrow Road
Columbia, SC 29203

From: Dean Williamson/CH2M-Jones

Date: June 25, 2004

Re: CH2M-Jones' Responses to Comments by SCDHEC regarding the *Corrective Measures Study Report, SWMU 6, Zone G, Revision 0* – Originally Submitted on October 14, 2003

We Are Sending You:

X	Attached	Under separate cover via	
	Shop Drawings	Documents	Tracings
	Prints	Specifications	Catalogs
	Copy of letter	Other:	

Quantity	Description
2	CH2M-Jones' Responses to Comments by SCDHEC regarding the *Corrective Measures Study Report, SWMU 6, Zone G, Revision 0* – Originally Submitted on October 14, 2003

If material received is not as listed, please notify us at once.

Copy To:

Dann Spariosu/USEPA, w/att
Rob Harrell/Navy, w/att
Gary Foster/CH2M-Jones, w/att

Comment Prepared by Jerry Stamps

1. Section 3.2.1 It is stated in the section that additional soil sampling will be conducted in the vicinity of G006GW005 in an effort to determine if Aroclor 1254 should be retained as a surface soil COC. It should be clearly stated that this sampling is to be conducted as a one time event for delineation purposes rather than ongoing sampling to be conducted as part of the LTM process. The text should also state what actions will be taken should the soil sample results identify contamination above the EPA Region III residential and industrial RTCs.

   CH2M-Jones Response:
   Since the time that the SWMU 6 CMS Report was submitted, surface soil in the vicinity of G006GW005 has been collected and analyzed for PCBs. The results for this sample are attached in Table 1 and indicate that no PCBs above the EPA Region III residential RBC were detected at this location. The detected concentration of Aroclor 1254 was 6.4 J µg/kg, well below the EPA Region III residential RBC of 320 µg/kg. Therefore, the uncertainty regarding the possible presence of residual PCB contamination at this location has been addressed, and it can be concluded that the surface soil meets the remediation objectives targeted during the previous soil interim measures and does not pose an unacceptable risk for either the industrial or unrestricted land use scenarios.

   We suggest that information regarding this sampling be incorporated into the text in Section 3.2.1 to indicate the soil is acceptably remediated and that further soil sampling is not needed.

Comments Prepared by Mansour Malik

1. Page 1-5, lines 20+; reference to the table 1.1, the text stated that "As the table indicates, significant turbidity was present in five of these wells during the sampling event that occurred in July 2002". In fact the table does not reflect a sound correlation between turbidity and contaminant concentration. In trying to correlate only the (=) qualified results, the reviewer failed to construct such a relationship.

   The Navy should introduce a better argument to establish such a correlation between those concentrations and the turbidity or review the sampling methodology.

   CH2M-Jones Response:
   The statement made on page 1-5 about the turbidity being elevated in five of these wells during the July 2002 sampling event is correct. As noted in the table provided by the reviewer, turbidities in samples collected from these wells had values of 100, 111, 142, and 151 Nephelometric Turbidity Units (NTUs). EPA guidance suggests that samples with turbidities greater than 10 NTUs be filtered, since excessive turbidity may significantly impact analytical results and provide results that are not truly representative of groundwater conditions. There is no need to identify a linear correlation between turbidity and pesticide concentrations for this argument to be valid. Turbidity is the measure of light scattering properties of a sample and is an indicator, but not a direct measurement, of suspended mass in a sample. Also, by dropping out the "U" and "J" data, the much smaller database used may have precluded a stronger correlation from being inferred. As previously noted, CH2M-

Jones suggests that both filtered and unfiltered groundwater samples be analyzed at this site to better understand the influence of these high turbidities on sample results.

2. Page 1-5, line 30 under Additional Groundwater Sampling: the text stated that "Turbidity levels were much lower during the December 2002 event than during the July 2002 sampling event." The text should elaborate more, offering an explanation for the occurrence.

CH2M-Jones Response:
No data on the reason for the higher turbidities during the July 2002 sampling event are available. However, the most likely reason is that the wells had not been sampled for 5 years prior to the July 2002 sampling and sediments had likely accumulated in the well over time.

3. Table 1.1 Page 1.11: The text on page 1-5, line 32 referred to table 1-3 to be including filtered and unfiltered samplings. The table does not reflect this fact. Please revise the table as indicated.

CH2M-Jones Response:
Both filtered and unfiltered data are included in Table 1-3. The filtered data are referred to as dissolved. Where the word dissolved is not present, the data are for unfiltered samples. A clarifying note about this can be added to this table.

4. The Aroclor 1254 concentrations in surface soil near monitoring well G006GW005 are a concern. The investigation has not yet determined whether this contaminant should be retained as a COC for unrestricted land use.

CH2M-Jones Response:
Please see our response to a similar comment made by Mr. Jerry Stamps/SCDHEC. Resampling at this location did not detect Aroclor 1254 concentrations above the EPA Region III RBC. Therefore, no additional concerns remain regarding surface soil COCs and Aroclor 1254 is not a COC for surface soil.

5. The Division of Hydrogeology agrees to the monitoring of the five downgradient monitoring wells as indicated in the Basewide Groundwater Monitoring Plan. The Navy should understand that the proposed groundwater monitoring plan is subject to re-evaluation upon detection of any significant change in the concentration of the monitored parameters.

CH2M-Jones Response:
Comment noted.

6. Page 3-1, Section 3.2.1 Alternative 1: Long-term Monitoring With LUCs: The text indicated that "The source of contamination has been removed from SWMU 6". It is premature to conclude that, since a proposal is still in effect to collect soil samples to verify further any residual contamination.

CH2M-Jones Response:
See response to Comment 4 above. The sampling has been completed and confirmed that residual soil contamination is not a concern.

7. Section 3.2 Alternative 1: Long term Monitoring With LUCs: The text stated that "With the source removed, natural attenuation processes, such as dispersion, dilution, and adsorption, are expected to mitigate groundwater contaminants that may be present and allow groundwater concentrations to achieve the target MCSs over time." The text, however, failed to clearly identify or establish MNA parameters required. Revision of this part of the text is required.

   CH2M-Jones Response:
   Clarification to this text can be provided. Because the natural attenuation processes that are expected to play a primary role in mitigation of the low pesticide concentrations in groundwater over time (dilution, dispersion, and adsorption) are physical processes that occur in all aquifers, the most important and conclusive monitoring that can be conducted to demonstrate that these processes are working is the analysis of the groundwater for the COCs (pesticides), as well as groundwater flow direction and downgradient concentrations. As previously noted, CH2M-Jones suggests that both filtered and unfiltered samples be collected during the next several sampling events to further determine the extent to which turbidity in the samples has influenced the sampling results.

8. The selected alternative of maintaining long-term groundwater monitoring with Land Use Controls (LUC) is an acceptable approach contingent on clarifying the above concerns.

   CH2M-Jones Response:
   Comment noted. See above responses for clarifications.

9. The Division of Hydrogeology recommends that the Navy address the above-mentioned concerns.

   CH2M-Jones Response:
   Comment noted. See above responses.

Table 1 - Results for Resampling of Surface Soil At Monitoring Well G006GW005

SampleID	DateCollected	Matrix	SampleType	ParamID	ParamName	AnaValue	ProbeQual	Units	CASNumber	ParamClass
006SB33301	11/17/2003 2:35:00 PM	SO	N	PCB1016	PCB-1016 (Arochlor 1016)	36.5	U	ug/kg	102195	PCB
006SB33301	11/17/2003 2:35:00 PM	SO	N	PCB1221	PCB-1221 (Arochlor 1221)	36.5	U	ug/kg	102195	PCB
006SB33301	11/17/2003 2:35:00 PM	SO	N	PCB1232	PCB-1232 (Arochlor 1232)	36.5	U	ug/kg	102195	PCB
006SB33301	11/17/2003 2:35:00 PM	SO	N	PCB1242	PCB-1242 (Arochlor 1242)	36.5	U	ug/kg	102195	PCB
006SB33301	11/17/2003 2:35:00 PM	SO	N	PCB1248	PCB-1248 (Arochlor 1248)	36.5	U	ug/kg	102195	PCB
006SB33301	11/17/2003 2:35:00 PM	SO	N	PCB1254	PCB-1254 (Arochlor 1254)	6.4	J	ug/kg	102195	PCB
006SB33301	11/17/2003 2:35:00 PM	SO	N	PCB1260	PCB-1260 (Arochlor 1260)	10.8	J	ug/kg	102195	PCB